nVent RAYCHEM

CONNECT AND PROTECT

Control and Monitoring

This section provides an overview and general design guidelines for nVent RAYCHEM control and monitoring systems. Part 1 identifies control and monitoring options for use with heat-tracing applications. Part 2 details each nVent RAYCHEM control and monitoring product. For complete design assistance, contact your nVent representative or visit our website at nVent.com/RAYCHEM.

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Introduction

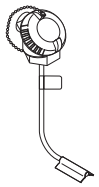
nVent provides a wide variety of control and monitoring products, from simple mechanical thermostats and signal lights to advanced microprocessor based controllers designed specifically for use with our heat-tracing products. This section will help you select and specify the right control and monitoring products for your application. For details on nVent RAYCHEM panel products such as the nVent HTPG and HTPI, refer to Heat-Tracing Power Distribution Panels (H56890).

Part 1: Control and Monitoring Options

PRODUCT OVERVIEW

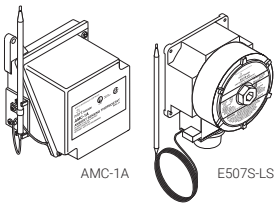
nVent RAYCHEM control and monitoring products include temperature sensors, thermostats, controllers, and control and monitoring systems. The following are descriptions of some of our most common products.

Temperature Sensors



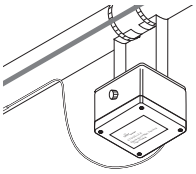
Temperature sensors are available in a variety of mounting styles, suitable for both ambient and line sensing applications as well as hazardous and ordinary locations. They can be used with most electronic thermostats and controllers.

Thermostats



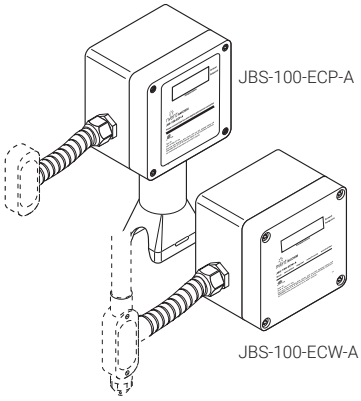
Mechanical Thermostats

Mechanical thermostats, such as the ambient-sensing AMC-1A and line-sensing E507S-LS, provide cost-effective control for self-regulating and constant-wattage heat-tracing applications in both nonhazardous and hazardous locations.



Electronic Thermostats

Electronic thermostats, such as the nVent RAYCHEM ETS-05, JBS-100-ECP-A and the JBS-100-ECW-A offer additional features including precise set points and long-lasting switches.



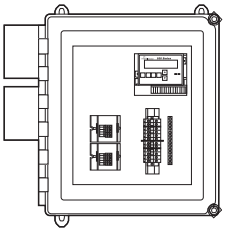
JBS-100-ECP-A and JBS-100-ECW-A

The nVent RAYCHEM JBS-100-ECP-A and JBS-100-ECW-A are electronic temperature controllers that provide accurate control of a heating circuit using a RTD sensor. The JBS-100-ECP-A is pipe mounted and serves as a power connection kit for both nVent RAYCHEM self-regulating, power-limiting, and nVent RAYCHEM mineral insulated heating cables. The JBS-100-ECW-A is wall mounted and may be used to control all types of heating cables. Only the JBS-100-ECW-A can be used as a power connection with mineral insulated cables. Combining the power connection and controller into one single unit will significantly reduce installation cost. Both the JBS-100-ECP-A and JBS-100-ECW-A have adjustable set points between 32°F to 425°F (0°C to 218°C), power input of 120 Vac to 277 Vac, and switch current up to 30 A. A local display allows for monitoring of set point, actual temperature, and also indicates alarm conditions (high/low temperature and sensor failure). A form C contact allows for remote annunciation of alarms. These units are c-CSA-us (certified to U.S. and Canadian Standards) for use in nonhazardous locations.

Single and Dual-Point Controllers

Electronic Controllers

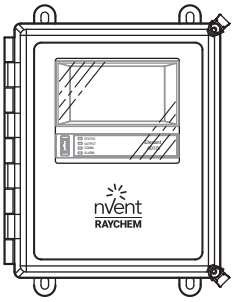
Electronic controllers are full-feature devices, and provide monitoring in addition to temperature control.



920

920

The nVent RAYCHEM 920 controller is a microprocessor-based dual-point controller for heat-tracing circuits located in nonhazardous or Class I Division 2 (and Zone 2) hazardous locations. The nVent RAYCHEM 920 combines the temperature control of a thermostat with integral ground-fault protection, while providing alarms for low and high temperatures, line current, and ground-fault current. Operation, programming, circuit status, currents, and temperatures are provided at the control panel and remotely by means of a network connection to the plant DCS or a PC using nVent RAYCHEM Supervisor software.



Elexant 4000 series

Elexant 4010i and 4020i

The nVent RAYCHEM Elexant 4010i is a compact, full-featured, touch screen based, single-point heat-tracing controller. It provides control and monitoring of Electric Heat Tracing (EHT) circuits for both freeze protection and process temperature maintenance. This controller can monitor and alarm on high and low temperature, high and low current, ground-fault levels, voltage, and supports a host of additional features to offer the utmost in control and monitoring of EHT.

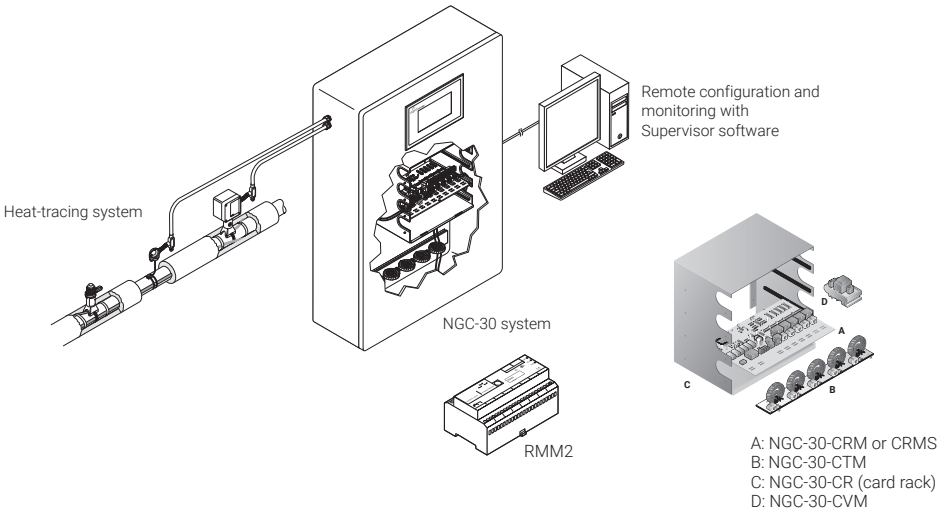
The nVent RAYCHEM ELEXANT 4020i is similar to an ELEXANT 4010i, but extends available features to include full 3-phase monitoring, support for higher power applications up to 690Vac and 63A, and may be used with either solid-state relays (SSRs) or electro-mechanical contactors. Its modular design lends itself to both single and multi-circuit applications.

Multipoint Controllers

NGC-30

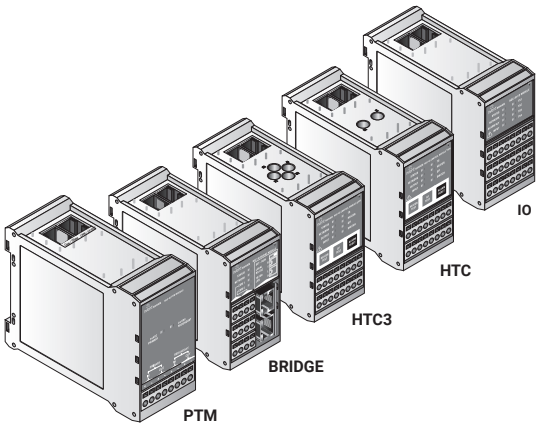
The nVent RAYCHEM NGC-30 is a distributed architecture control and monitoring system that can manage up to 260 heat-tracing circuits. Approved for use in both hazardous and nonhazardous areas, it allows user selection of several control modes, temperature setpoints and all alarm thresholds for each individual heat-tracing circuit. During operation it monitors temperatures, ground-fault currents, operating currents and voltages and provides alarms via local indicators and remotely using dry contact relay outputs or through the Supervisor software. The NGC-30 system utilizes a touch screen-based user interface terminal for programming and monitoring at the panel. This user interface terminal provides an intuitive interaction with the control and monitoring system which allows users to quickly and easily access heat-tracing system information. Alarm information is communicated in plain language rather than using codes.

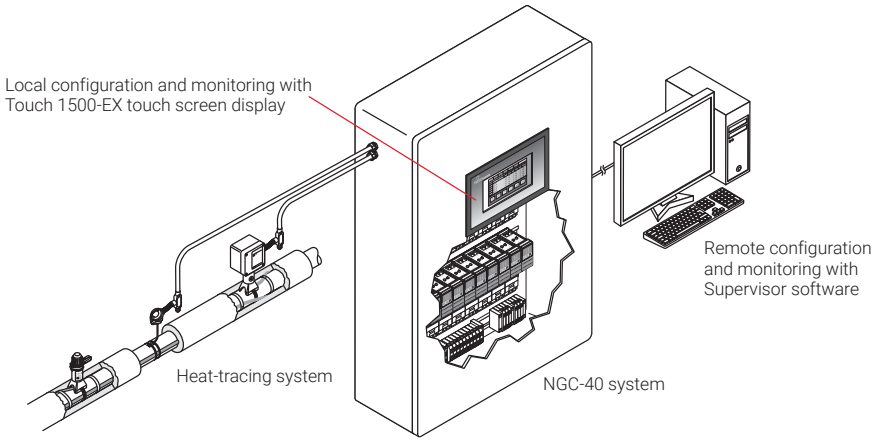
Temperature inputs are provided through directly connected RTDs, through a Remote Monitoring Module (RMM2) or through a Power Line Carrier Interface (PLI) Module with special transmitters. Operation, programming, circuit and RTD status and alarm reporting are provided at the control panel or remotely via a network connection to the plant DCS or the Supervisor software.



NGC-40

The nVent RAYCHEM NGC-40 control and monitoring system differs from the NGC-30 in that it dedicates a single control module to each individual heat-trace circuit. It provides the highest reliability for heat tracing applications based on its single controller architecture. The NGC-40 control system offers a truly modular heat-tracing control, monitoring and power distribution system. NGC-40 modules are packaged in DIN Rail housings and are installed in an NGC-40 panel. Operation, programming and easy intuitive access to the heat tracing data can be achieved from an optional 15" touch screen (Touch 1500-EX) which can be mounted locally at the control panel or remotely in a central location. Additionally, the NGC-40 supports remote operation, programming, circuit and RTD status, and alarm reporting via a network connection to the plant DCS or the nVent RAYCHEM Supervisor software. The system is fully flexible from a configuration point of view and offers individual single-phase and three-phase electrical heat-tracing control and monitoring.

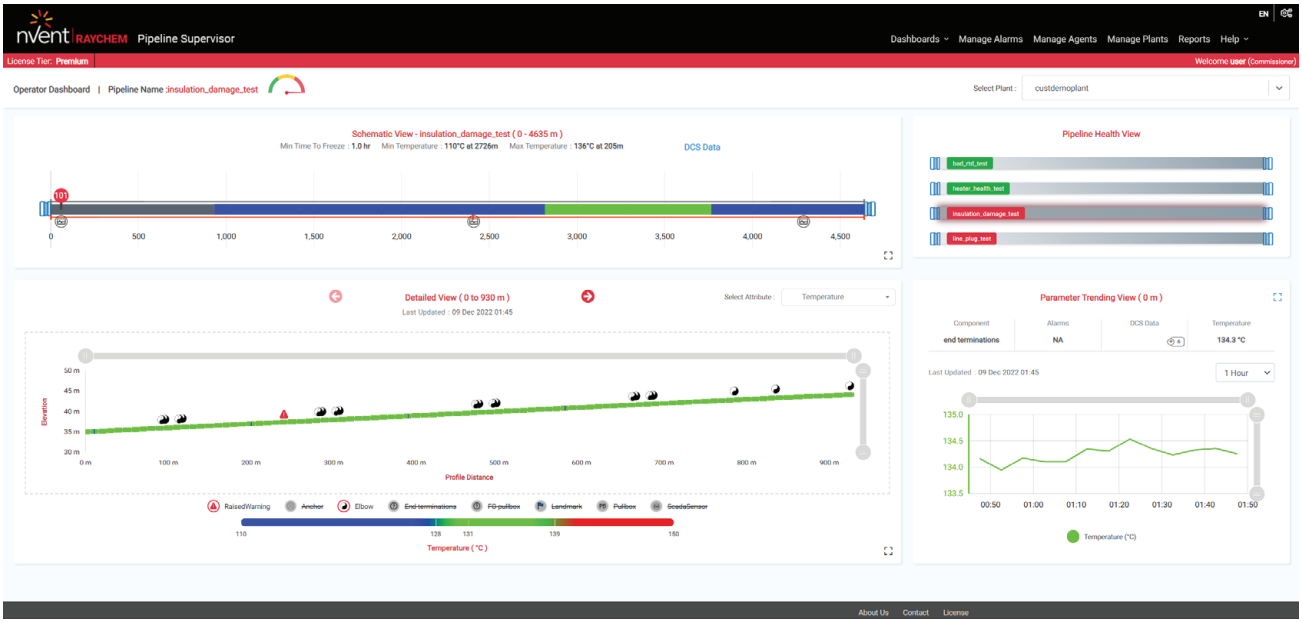




nVent RAYCHEM Pipeline Supervisor

Pipeline temperature monitoring on an operating pipeline is very helpful, but often severely underutilized due to operator inattention or lack of data interpretation skills. This is why customized algorithms and machine learning, when combined with fibre optic Distributed Temperature Sensing (DTS), can bridge the gap between “data” and actionable “information”.

nVent RAYCHEM Pipeline Supervisor (RPS) is a culmination of nVent's many years of experience troubleshooting, optimizing and maintaining our clientele's temperature-critical pipeline applications. We combined the power of distributed temperature data from DTS with specially customized algorithms that create a wealth of useful analytics, on a real-time basis. These analytics are configured to your specific pipeline geometry and use time trending to create warnings/alarms of predicted conditions along your pipeline, while also providing the time and location where problems are occurring (or may be about to occur), along your pipeline asset.

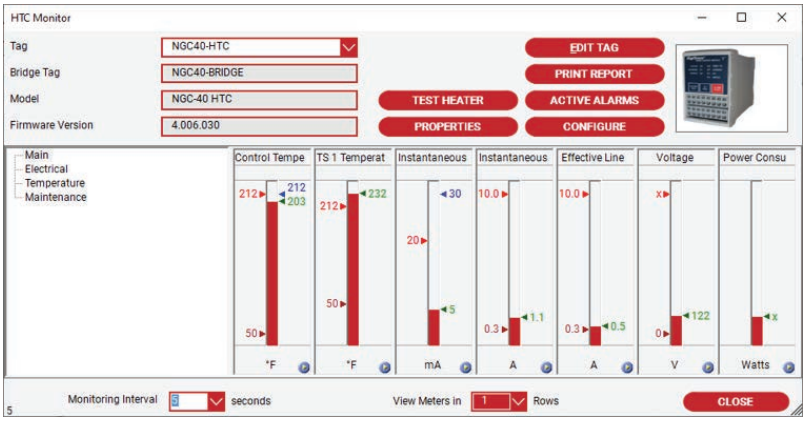


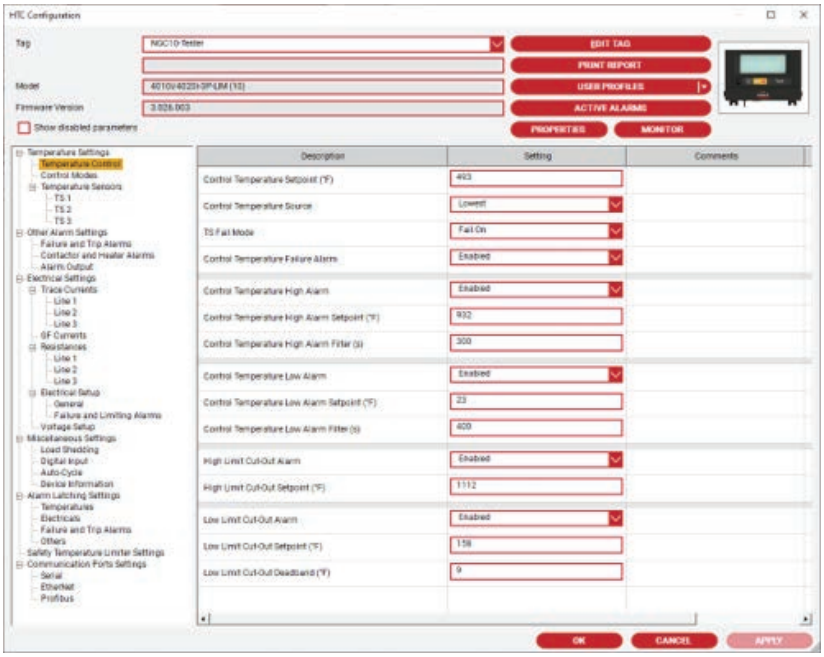
nVent RAYCHEM Pipeline Supervisor Software GUI Dashboard

nVent RAYCHEM Supervisor

nVent RAYCHEM Supervisor heat-tracing controller configuration and monitoring software provides a graphical user interface for nVent RAYCHEM heat-tracing communication and controller products. Heat-trace system information can be accessed and managed from almost anywhere in the world, making nVent RAYCHEM Supervisor a powerful management tool for the entire Heat Management System (HMS).

The software incorporates advanced features such as datalogging, trending, batch and recipe processing, scheduled events, and alarm monitoring, with the ability to acknowledge and clear alarms. Devices can communicate with nVent RAYCHEM Supervisor via simple hard-wired serial communications, wireless interfaces, network infrastructures including Ethernet LANs (Local Area Networks), and Internet-based WANs (Wide Area Networks).





Connectivity

nVent RAYCHEM connectivity solutions provide ultimate flexibility to connect our control systems to the entire facility. Our systems support Modbus RTU and Modbus/ TCP communications protocols with RS-485 and Ethernet communications interface capabilities. We also provide options for DCS integration, pre-packaged communications converters, repeaters, and field proven wireless solutions ensuring that your facility is IIoT and Industry 4.0 ready.

Control products vary the output of the heating source to keep pipes from freezing or to maintain process piping at elevated temperatures. The choice of control product depends on whether the system is controlled on the basis of ambient temperature or pipe temperature.

Most heat-tracing systems use a control element. Applications that may benefit from a control element are those:

- Requiring a narrow operating temperature range
- With temperature-sensitive fluids or equipment
- For which energy consumption is a key concern

Control Considerations

The most important step in providing a reliable control system is to design the heat-tracing system properly for the specific application.

Heat-tracing systems maintain the temperature of stagnant fluids in pipes and tanks by replacing the heat lost through the thermal insulation. Overall performance of the heat-tracing system is highly dependent on the integrity of the thermal insulation, the heat-tracing design, and the installation. Therefore, the most important step in providing a reliable control system is to properly design the heat-tracing system for the specific application, as detailed in other nVent design guides.

When designing your heat-tracing system, consider these factors:

- Adding control elements increases the installation and maintenance costs of the system, but should result in tighter temperature control, energy savings and more efficient use of plant maintenance personnel's time
- Electronic controllers increase initial system costs, but offer reliability and feedback superior to that provided by mechanical thermostats and save money over the long term. The monitoring and alarm information available from electronic controllers can help maintenance personnel react to heat-tracing problems more quickly, before pipe freeze-up or process temperature issues cause a plant or process shutdown
- The thermal environment of a heat-tracing system varies greatly — especially at valves, pipe supports, and other heat sinks — so it is seldom possible to achieve very tight temperature control
- The temperature of a heat tracing system is based on ambient temperature and can vary by as much as 40°C when the system is uncontrolled. However, pipe temperature sensing will provide tighter temperature control than is possible with ambient sensing
- TraceCalc Pro, nVent design software, estimates the temperature range of your heat-tracing system, both with and without control. If an uncontrolled self-regulating heating cable provides an acceptable range, consider choosing this approach for its high reliability and low installed cost

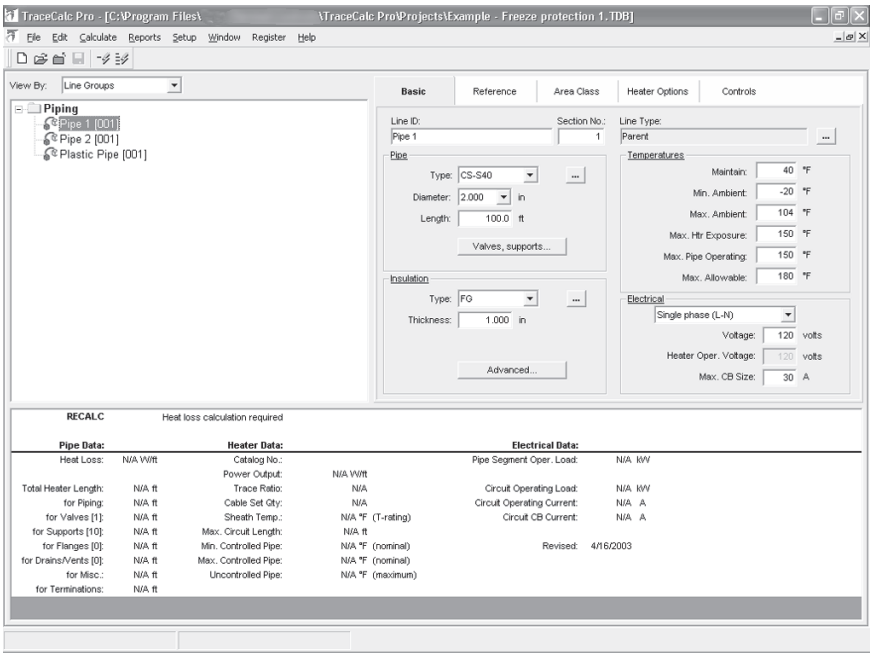


Fig 1. TraceCalc Pro heat-tracing design software

Application Temperature Range

The options for control depend on the expected temperature range for the application. Ranges are grouped into three categories, as follows:

Freeze Protection

Freeze protection applies to fluids that must be kept above a minimum temperature, typically 32°F (0°C) for water lines. Moderate overheating of the fluid (30°F to 40°F; 17°C to 22°C) is not a major concern. (IEEE 515-2011, Process Type I)

Broad Temperature Maintenance

Broad temperature maintenance is appropriate when the process temperature must be controlled within a moderate range; e.g., set point plus approximately ΔT= ± 35°F ± (19°C). This is generally used for viscosity control to keep process fluids flowing, such as in fuel oil and cooking oil lines. (IEEE 515-2011, Process Type II)

Narrow Temperature Maintenance

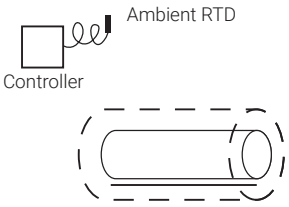
Narrow temperature maintenance applies to fluids that must be kept within a narrow temperature range to maintain viscosity and prevent fluid or pipe degradation. Examples include sulfur and acrylic acid lines, as well as food syrup and sugar solutions. (IEEE 515-2011 Process Type III)

Control Options

The control method you select will be driven by your application. Table 1 summarizes the recommended control options for each application type. Following the table is an overview of the three basic control types: ambient-sensing, proportional ambient-sensing (PASC), and line-sensing control.

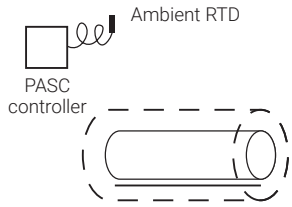
Table 1. Recommended control methods

Application	Control methods recommended
Freeze protection	Ambient-sensing control to reduce energy consumption Proportional ambient-sensing control (PASC) for lowest energy consumption
Broad temperature maintenance	Proportional ambient-sensing control (PASC) for tighter temperature control
Narrow temperature maintenance	Line-sensing control



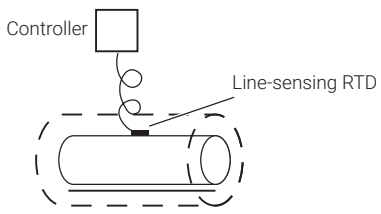
Ambient-Sensing Control

Ambient-sensing control uses an on-off thermostat that senses ambient temperature. It is more energy efficient than self-regulating control because the heating circuit is energized only when the temperature drops below the setpoint. This type of control is most suitable for freeze-protection applications. The control device can be either a mechanical thermostat or an electronic controller. Mechanical thermostats are more commonly used since they are less expensive and are sufficiently accurate and reliable. However, they do not provide the monitoring and alarm functions that are available from an electronic controller.



Proportional Ambient-Sensing Control (PASC)

Proportional ambient-sensing control (PASC) uses an electronic controller that senses ambient temperature and continuously matches the heat-tracing power applied to the pipe to the predicted heat loss that occurs due to changing ambient conditions. A preprogrammed algorithm calculates the cycle time that the heating circuits will be energized in order to maintain the desired temperature. This control method results in tighter temperature range control and lower energy usage than the ambient-sensing method. PASC control is suitable for all broad temperature-control and some narrow temperature-control applications, as well as freeze-protection applications.



Line-sensing Control

Line-sensing control is based on pipe temperature. With this option, each flow path must have a separate circuit controlled by a mechanical line-sensing thermostat or electronic controller. When the pipe temperature falls below the desired maintain temperature, the control unit turns on the heating circuit. The same cost-benefit trade-offs between electronic and mechanical controllers should be made for line-sensing applications. An electronic controller with monitoring and alarm features is recommended for critical pipes.

Control Selection

Selecting a control system suitable for your application involves four steps:

1. Select the nVent heat-tracing solution
2. Identify the control application
3. Choose the control method
4. Review the specifications for your control selection

The selection process outlined on the following pages results in a reliable, cost-effective control system optimized for simplicity. If you are installing multiple heat-tracing circuits, a more detailed analysis of the application may yield a different result with lower installed and operating costs. Contact your nVent representative for assistance.

Control Selection
1. Select nVent heating solution
2. Identify control application
3. Choose control method
4. Review specifications for control selection

Step 1. Select the nVent heating solution

This is the most important step in designing a heat-tracing system. Use the heat-tracing product selection sections in this publication to select the heating system and components for your application. Assistance is available on-line (nVent.com), in nVent TraceCalc Pro design software, or from your nVent representative.

Control Selection
1. Select nVent heating solution
2. Identify control application
3. Choose control method
4. Review specifications for control selection

Step 2. Identify the control application

For the pipes and tanks to be heated, identify the specific control application in Table 2.

Table 2. Categories of control

Control application	Temperature range/goal
Freeze protection	To keep water lines above 32°F (0°C)
Broad temperature control	For viscosity control to keep process fluids flowing
Narrow temperature control	To keep process fluids within a narrow temperature band to maintain viscosity and prevent fluid degradation

If your project includes multiple heat-tracing circuits and a combination of applications, or monitoring and alarm reporting capability is desired, use the NGC-30 or NGC-40 control and monitoring system and contact your nVent representative for design assistance. Otherwise, continue to Step 3 to select your control method.

Control Selection
1. Select nVent heating solution
2. Identify control application
3. Choose control method
4. Review specifications for control selection

Step 3. Choose the Control Method

For Freeze-Protection Applications

Use Table 3 to select the appropriate control solution for your application. Base your selection on the number and type of heat-tracing circuits to be installed, the type of control you need, and the area classification. Other nVent products that include monitoring and ground-fault protection are discussed later under "Monitoring Solutions."

Table 3. Control selection for freeze protection

nVent heating solution: individual circuits[1]	Control options	nVent RAYCHEM control product	Quantity required
Self-regulating heating circuits on pipes	Ambient-sensing control	AMC-1A, AMC-1H, JBS-100-ECP-A, or JBS-100-ECW-A	One per circuit
Constant-wattage/ power-limiting heating circuit(s) on pipes (includes MI and VPL cables)	Line-sensing control	AMC-1B, E507S-LS, 920, ETS-05, Elexant 4010i, Elexant 4020i, JBS-100-ECP-A, or JBS-100-ECW-A	One per circuit
Any heating circuit(s) on tanks	Line-sensing control	AMC-1B, E507S-LS, 920, ETS-05, Elexant 4010i, Elexant 4020i, JBS-100-ECP-A, or JBS-100-ECW-A	One per circuit
Multiple circuits[1] grouped in panels			
Self-regulating heating circuits on pipes	Ambient-sensing control for main contactor in panel	HTPG, HTPI	One per system
	Energy-saving electronic proportional control for main contactor in panel	NGC-30, NGC-40, 920, Elexant 4010i, and Elexant 4020i	One per system
Constant-wattage/ power-limiting heating circuits on pipes	Proportional control for each contactor in panel	NGC-30, NGC-40, 920, Elexant 4010i, and Elexant 4020i	One per system
Any heating circuits on tanks	Multicircuit line-sensing control	NGC-30, NGC-40, 920, Elexant 4010i, and Elexant 4020i	One per system

1. A heat-tracing circuit is defined as one circuit breaker with its associated branch wiring, heat-tracing cable, and components.

For broad temperature control applications

Use Table 4 to select the appropriate control solution for your application. Base your selection on the number and type of heat-tracing circuits you will use in your application, the desired control option, and the area classification. Other nVent products that include monitoring and ground-fault protection are discussed later under "Monitoring Solutions."

Table 4. Control selection for broad temperature control

nVent heating solution: individual circuits[1]	Control options	nVent RAYCHEM control product	Quantity required
Self-regulating heating circuits on pipes	Line-sensing control	AMC-1B, E507S-LS, ETS-05, JBS-100-ECP-A, or JBS-100-ECW-A	One per circuit
Constant-wattage/power-limiting heating circuits on pipes (includes MI, SC and VPL cables)	Line-sensing control for each circuit; maintain temperature less than 300°F (150°C)	AMC-1B, E507S-LS, ETS-05, JBS-100-ECP-A, or JBS-100-ECW-A	One per circuit
	Line-sensing control for each circuit; maintain temperature greater than 300°F (150°C)	JBS-100-ECP-A, or JBS-100-ECW-A, 920, ETS-05, Elexant 4010i, Elexant 4020i	One per circuit
Any heating circuit(s) on tanks	Line-sensing control	AMC-1B, E507S-LS, JBS-100-ECW-A or 920, ETS-05, Elexant 4010i, Elexant 4020i	One per circuit
Multiple circuits[1] grouped in panels			
Any heating circuits on pipes	Multicircuit proportional ambient-sensing control (PASC)[2]	NGC-30, NGC-40, Elexant 4020i	One per system
	Multicircuit line-sensing control	NGC-30, NGC-40, 920, Elexant 4020i	One per system
Any heating circuits on tanks	Multicircuit line-sensing control	AMC-1B, E507S-LS, NGC-30, NGC-40, 920, Elexant 4020i	One per system

1. A heat-tracing circuit is defined as one circuit breaker with its associated branch wiring, heat-tracing cable, and components.
2. The NGC-30, NGC-40, 920, Elexant 4010i, and Elexant 4020i controllers include approved ground-fault protection, so a ground-fault circuit breaker in the panel is not required.

For narrow temperature control applications

Use Table 5 to select the appropriate control solution for your application. Base your selection on the number and type of heat-tracing circuits you will use in your application, the desired control option, and the area classification. Other nVent products that include monitoring and ground-fault protection are discussed later under "Monitoring Solutions."

Table 5. Control selection for narrow temperature control

nVent heating solution: individual circuits[1]	Control options	nVent RAYCHEM control product	Quantity required
Heating circuits on pipes or tanks	Line-sensing control for each circuit; maintain temperature less than 300°F (150°C)	AMC-1B, E507S-LS, ETS-05, Elexant 4010i, Elexant 4020i, 920, JBS-100-ECP-A, or JBS-100-ECW-A	One per circuit
	Line-sensing control for each circuit; maintain temperature greater than 300°F (150°C)	JBS-100-ECP-A, JBS-100-ECW-A or ETS-05, Elexant 4010i, Elexant 4020i, 920	One per circuit
Multiple circuits[1] grouped in panels			
Any heating circuits on pipes	Multicircuit line-sensing control	NGC-30, NGC-40, Elexant 4020i or 920	One per system
Any heating circuits on tanks	Multicircuit line-sensing control	NGC-30, NGC-40, Elexant 4020i, 920	One per system

1. A heat-tracing circuit is defined as one circuit breaker with its associated branch wiring, heat-tracing cable, and components.

Control Selection
1. Select nVent heating solution
2. Identify control application
3. Choose control method
4. Review specifications for control selection

Step 4. Review the specifications for your control selection

You will find descriptions of each of the control products in Control and Monitoring, Part 2; data sheets for these products are available on the nVent web site. Review the technical specifications of each product you have selected to ensure the product meets the needs of your application.

MONITORING SOLUTIONS

While you may select only one method of control for each heat-tracing circuit, you may incorporate a variety of monitoring options into the system design. The use of monitoring increases overall system reliability because failures in the heating and power distribution systems get reported to operations personnel.

nVent recommends always using, at a minimum, ground-fault monitoring. For the small additional cost, you get a monitoring system that reliably reports physical damage to the heat-tracing system, which is a common failure mode.

For critical applications, add temperature and/or current monitoring. This technique gives the most direct feedback on system performance. Multiple sensors can be placed at critical components.

To bring monitoring and alarm reporting from all heat-tracing circuits, use the Supervisor software located in the control or operations room.

Types of Monitoring

Monitoring increases system reliability by detecting faults before they become a major problem.

There are several methods available for monitoring heat-tracing systems. Local and remote feedback can be provided on ground-fault levels, pipe temperatures, heating cable current, and continuity.

Ground-fault monitoring

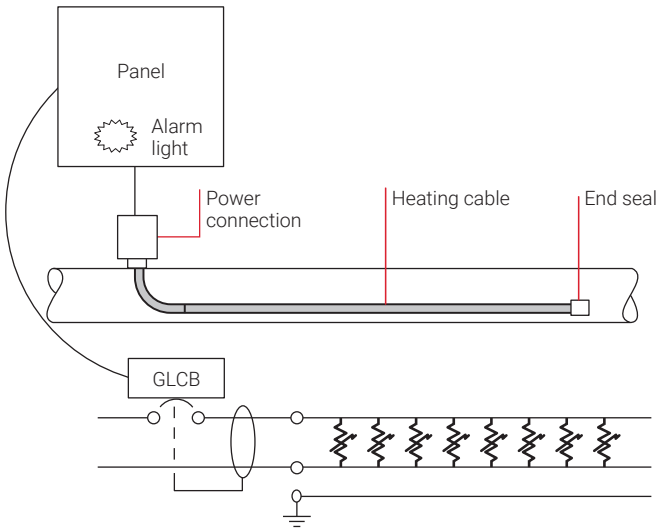


Fig 2. Ground-fault monitoring: GLCB status

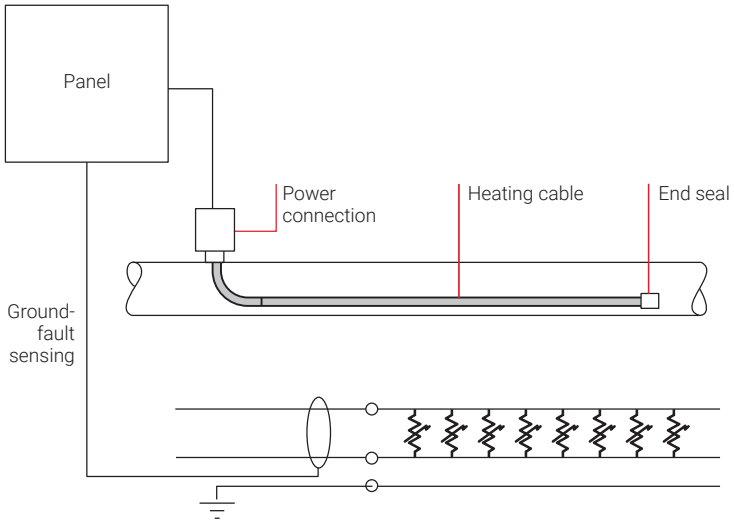


Fig 3. Ground-fault monitoring of actual G-F current

A ground-fault monitoring system monitors the current leakage from the heating system (heating cable, power wiring, and components) to ground, using ground-leakage circuit breakers and/or current-sensing devices that measure the current. Standard circuit breakers do not provide adequate protection because they are not designed to detect the low-level ground-fault currents that may be produced as a result of improper installation or mechanical damage.

National electrical codes and other local codes require ground-fault equipment for heat-tracing circuits. These protective devices are designed to reduce the risk of fire and to safeguard equipment, rather than personnel. Ground-fault interrupters (GFIs) specified for personnel protection normally have a 4 mA to 6 mA trip setting that may lead to frequent nuisance tripping in heat-tracing applications.

When a heat-tracing circuit's current leakage exceeds the trip setting, the protective device trips, shutting off the circuit. If the protective device is a Ground Leakage Circuit Breaker (GLCB), it may have an auxiliary (bell alarm) contact to trigger a common remote trip alarm. Other protective devices can also trigger alarms, as well as interrupt the circuit.

Alarms and trips are usually caused by improper installation, mechanical damage to the heating cable or power wiring, or moisture in junction boxes or end seals. Since these are typically accompanied by ground-fault current, ground-fault detection provides a significant monitoring function for electrical heat tracing.

Strengths of ground-fault monitoring

Strengths of ground-fault monitoring include:

- Quick detection of potentially dangerous fault conditions due to improper installation, mechanical damage, or water ingress
- Easy grouping and wiring of alarms to a remote location

nVent provides a range of ground-fault sensors and equipment-protection GFCIs, which provide CSA and UL-approved ground-fault current protection for heating circuits.

Temperature monitoring

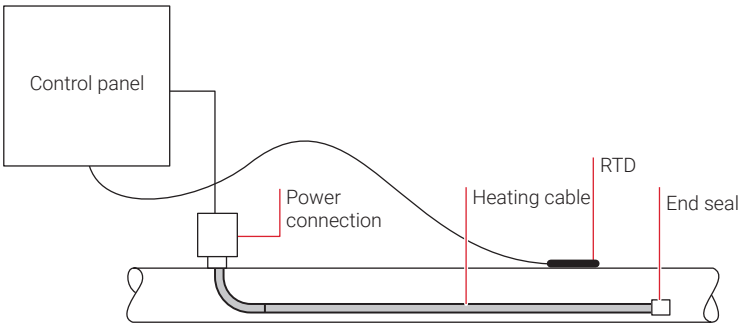


Fig 4. Temperature monitoring

Temperature monitoring systems continuously measure the pipe or tank temperature and signal an alarm if preset limits are exceeded. A digital controller uses an RTD temperature sensor placed on the pipe or tank to check the pipe temperature against the low and high limits, which are typically set 20°F (10°C) above and below the normal control range of the circuit.

Low-temperature alarms

One or more of the following conditions can cause a low-temperature alarm:

- Loss of power to the heating cable
- Wet or missing thermal insulation
- Heating cables with insufficient power output
- Control failure, or controller left in OFF position
- Heating cable failure

High-temperature alarms

High-temperature monitoring is typical in applications such as safety showers, plastic pipes and tanks, and processes in which an overtemperature condition can adversely affect the fluid properties. Any of the following conditions can cause a high-temperature alarm:

- Fluid temperature that exceeds the alarm limit, such as during steam-cleaning operations
- Controller failure or controller left in the ON position
- A site installation condition that differs from the design parameters; e.g., oversized insulation

Strengths of temperature monitoring

Following are the primary advantages of temperature monitoring:

- Dedicated to monitoring pipe temperature, the most critical aspect of heat tracing
- Effective for monitoring failures in other systems, including thermal insulation, design, and process
- Relatively simple to apply in any environment, with any heating system, and at any location
- Provides timely indication of fault condition allowing repairs to be implemented before costly shutdowns or catastrophic mechanical failures occur

Current Monitoring

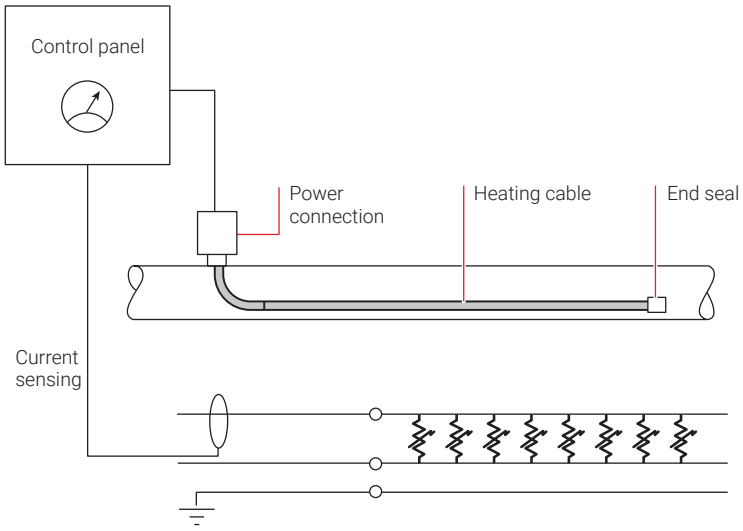


Fig 5. Current monitoring

Current monitoring uses a heat-tracing controller or current-monitoring relay to signal an alarm when electrical current in the circuit is too low or too high. This monitoring method is especially effective for constant-wattage heating products because their current usually does not vary over time or temperature.

The current flowing in self-regulating cables will vary significantly based on the heating requirements of the pipe at a particular moment in time. Therefore, current monitoring is only effective at identifying short or open conditions for self-regulating cable.

The following conditions typically cause an alarm from a current-monitoring system:

- Loss of power to the heating cable, or a tripped circuit
- Damage to the heating cable bus wires or branch-circuit wiring
- Splices or tees left open after repair or maintenance

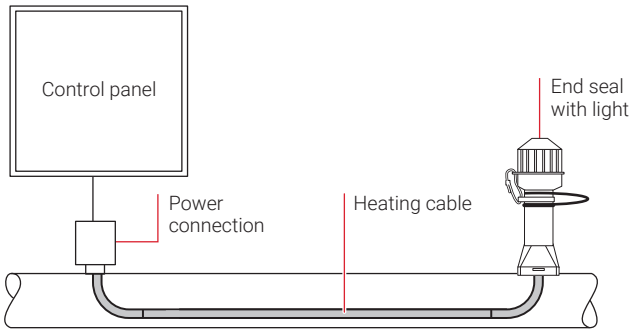
Strengths of current monitoring

- Alarms from current monitors can be grouped in a central location
- Power loss to the heating system is reported
- Unpowered sections of heat-tracing cables will result in low-current alarms

nVent RAYCHEM 920 dual-point controller, NGC-30, and NGC-40 systems offer current monitoring with low and high alarm settings and remote annunciation.

Continuity monitoring

Continuity monitoring is a technique used to verify that the heating-cable circuit has voltage present at the far end (termination end). Continuity monitoring is often provided by a signal light installed as part of the end seal, which provides a local visual indication of voltage presence at the end of the heating-cable circuit. This equipment is called an end-of-circuit light (E-100-L-A).



Strengths of continuity monitoring

Lighted End Seals have several key advantages:

- Low installed cost; adding a light to an end seal is inexpensive
- Upgradable critical lines; lights can be retrofitted to existing end seals
- Heat-tracing failure detection, including damaged cables and tripped breakers
- Simplified troubleshooting; there is no need to open junction boxes or use contact test tools
- Used in parallel circuits with good results

The nVent RAYCHEM lighted end seal, the E-100-L-A, provides bright LED indication at a low installed cost.

Monitoring Selection

Selecting a monitoring method suitable for your application is a three-step process:

1. Select the control method
2. Identify the monitoring application
3. Choose the monitoring method

As with heat-tracing control, monitoring is not always required. Choose the level of monitoring appropriate to the level of criticality of your process.

Monitoring Selection
1. Select control method
2. Identify monitoring application
3. Choose monitoring method

Step 1. Select the control method

Although control and monitoring choices can be made independently, in practice, the type of control solution you select influences your monitoring choice. For example, using the nVent RAYCHEM NGC-30 or NGC-40 system for control allows easy addition of temperature monitoring.

Monitoring Selection
1. Select control method
2. Identify monitoring application
3. Choose monitoring method

Step 2. Identify the monitoring application

The sophistication of the monitoring technique generally depends on the type of heat-tracing application. Choose your application from Table 6 as you did for control selection.

Table 6. Categories of heat-tracing applications

Application	Temperature range/goal
Freeze protection	To keep water lines above 32°F (0°C) (IEEE 515-2011 Process Type I)
Broad temperature control	For viscosity control to keep process fluids flowing (IEEE 515-2011 Process Type II)
Narrow temperature control	To keep process fluids within a narrow temperature band to maintain viscosity and prevent fluid degradation (IEEE 515-2011 Process Type III)

Monitoring Selection
1. Select control method
2. Identify monitoring application
3. Choose monitoring method

Step 3. Choose the monitoring method

Freeze-protection applications

Use Table 7 to select the appropriate monitoring solution for your application. Base your selection on the number of heat-tracing circuits to be installed, the control method you've chosen, and the criticality of the process being protected. Examples of critical freeze-protection lines include process water feed lines, safety showers, and fire water lines.

Table 7. Monitoring selection for freeze protection

Number of heat-tracing circuits	Control method	Criticality	nVent RAYCHEM monitoring method[1]	Quantity required
One or more individual heating circuits	Self-regulating (no control), ambient-sensing or line-sensing thermostat	Not critical	Ground-fault monitoring via GLCB	One GLCB per circuit
		Critical	Current temperature and ground-fault monitoring via Elexant 4010i, Elexant 4020i[2] and 920[2]	One per every one (Elexant 4010i and Elexant 4020i) or two (920) circuits
Multiple circuits	Ambient-sensing, line-sensing, or energy-saving proportional control	Not critical	Ground-fault monitoring via GLCB	One GLCB per circuit with one common alarm for panel
		Critical	Current, temperature and ground-fault monitoring via Elexant 4020i, NGC-30 or, NGC-40[2]	One per system

1. Add the E-100-L-A lighted end seal to any choice for easier troubleshooting.
2. Replace the mechanical or electronic thermostat you selected under "Control Selection" with this unit.

Broad temperature control applications

Use Table 8 to select the appropriate monitoring solution for your application. Base your selection on the number of heat-tracing circuits to be installed, the control method you've chosen, and the criticality of the process being traced. Criticality for broad temperature control generally means the system should alarm when pipe or tank temperature drops below a predetermined limit.

Table 8. Monitoring selection for broad temperature control

Number of heat-tracing circuits	Control method	Criticality	nVent RAYCHEM monitoring method[1]	Quantity required
One or more individual heating circuits	Self-regulating (no control), or line sensing thermostat	Not critical	Ground-fault monitoring via GLCB	One GLCB per circuit
		Critical	Current temperature and ground-fault monitoring via Elexant 4010i, Elexant 4020i and 920[2]	One per circuit
Multiple circuits	PASC or multicircuit line sensing control	Not critical	Ground-fault monitoring via GLCB with common alarm to controller	One GLCB per circuit
		Critical	Current, temperature and ground-fault monitoring via Elexant 4020i, NGC-30 or NGC-40[2]	One per system

1. Add the E-100-L-A lighted end seal to any choice for easier troubleshooting.
2. Replace the mechanical or electronic thermostat you selected under "Control Selection" with this unit.

Narrow temperature control applications

Use Table 9 to select the appropriate monitoring solution for your application. Base your selection on the number of heat-tracing circuits to be installed and the control method you've chosen. All narrow control applications are considered critical.

Table 9. Monitoring selection for narrow temperature control

Number of heat-tracing circuits	Control method	Criticality	nVent RAYCHEM monitoring method[1]	Quantity required
One or more individual heating circuits	Line sensing thermostat	Critical	**Temperature monitoring** via Elexant 4010i, Elexant 4020i or 920[2]	One per circuit
Multiple circuits	Multicircuit line sensing control	Critical	**Temperature monitoring** via Elexant 4020i, NGC-30 or NGC-40[2]	One per system

1. Add the E-100-L-A lighted end seal to any choice for easier troubleshooting.
2. Replace the mechanical or electronic thermostat you selected under "Control Selection" with this unit.

Additional Considerations

The selection tables in this section provide control and monitoring solutions for the majority of heat-tracing applications. Review the following additional considerations and discuss any unusual applications or requirements with your nVent representative.

If your design selection includes a mechanical thermostat and ground-fault circuit breaker for each heat-tracing circuit, consider instead using the Elexant 4010i single-point controller or 920 multipoint controller. These replace both the mechanical thermostat and the ground-fault circuit breaker, and provide temperature, ground-fault, and current monitoring in a rugged industrial package.

If multiple heat-tracing circuits are to be installed at the same time, there are significant opportunities for installation, operation, and maintenance cost savings. nVent representatives can help optimize your system by choosing the best combination of heat-tracing products and control and monitoring systems.

If you plan to connect your heat-tracing control and monitoring equipment to a host computer or DCS in your facility, consider the Elexant 4010i, Elexant 4020i, 920, NGC-30 or NGC-40. All offer extensive networking capabilities, as well as computer-based Supervisor software.

If your application requires long runs of temperature-sensor cable or conduit, consider the NGC-30 with the RMM2.

The RMM2 is an 8-point RTD module located in the field. Up to 16 RMM2 modules can be connected together via RS485 twisted pair cable back to the NGC-30 or NGC-40 controller.

Part 2: Control and Monitoring Design and Details

Control and Monitoring Systems

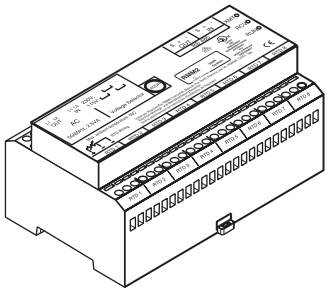
Compare features of nVent control and monitoring systems in Table 10.
For additional information on each product, see the descriptions that follow and the data sheets.

Table 10. nVent control and monitoring products

	Thermostats							Controllers				
	Mechanical					Electronic		Single/Dual Circuit			Multi-Circuit	
nVent RAYCHEM	AMC-1A / AMC-F5	AMC-1B / AMC-2B-2	AMC-1H	E507S-LS	E507-2LS-2	ETS-05	JBS-100-ECx-A	920	Elexant 4010i	Elexant 4020i	NGC-30	NGC-40
Controller architecture												
Single circuit	✓	✓	✓	✓	✓	✓	✓		✓	✓		✓
Multi-circuit								✓			✓	
Control												
Ambient sensing	✓		✓			✓	✓	✓	✓	✓	✓	✓
Line sensing		✓		✓	✓	✓	✓	✓	✓	✓	✓	✓
PASC / Proportional Ambient								✓	✓	✓	✓	✓
Multiple Temperature Sensors								✓	✓	✓	✓	✓
Soft-start								✓	✓	✓	✓	✓
Autocycle								✓	✓	✓	✓	✓
Max Load	22A/ 480V	22A/ 240V	22A/ 480V	22A/ 480V	22A/ 240V	24A/ 277V	30A/ 277V	60A/ 600V	32A/ 277V	63A/ 690V	60A/ 600V	60A/ 600V
Monitoring												
Temperature							✓	✓	✓	✓	✓	✓
Ground Fault								✓	✓	✓	✓	✓
Current								✓	✓	✓	✓	✓
Voltage								✓	✓	✓	✓	
3-Phase loads								✓		✓	✓	✓
Installation location												
Local	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Remote						✓	✓	✓	✓	✓	✓	✓
Hazardous Area			✓	✓	✓	✓		✓	✓	✓	✓	✓
Interface												
Local display							✓	✓	✓	✓	✓	✓
Remote display								✓	✓	✓	✓	✓
Alarm Relay							✓	✓	✓	✓	✓	✓
Communications												
(DCS) Distributed Control System								✓	✓	✓	✓	✓
nVent RAYCHEM Supervisor								✓	✓	✓	✓	✓

nVent provides a variety of temperature sensing solutions. From RTDs to temperature aggregation and communications, nVent RAYCHEM products meet every application need and help reduce installation costs.

RMM2 (Remote Monitoring Module)

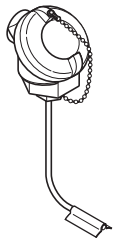


The nVent RAYCHEM remote monitoring module (RMM2) provides temperature monitoring capability for the NGC-30 and NGC-40 heat-tracing control and monitoring systems. The RMM2 accepts up to eight RTDs that measure pipe, vessel, or ambient temperatures in a heat-tracing system. The RMM2 modules are used to aggregate RTD wires in one remote location and send the information back to the control system through a single twisted pair cable. This helps reduce installation costs since only one conduit run returns to the controller, rather than eight. Multiple RMM2s communicate with a single NGC-30 or NGC-40 to provide centralized monitoring of temperatures. A single, twisted pair RS-485 cable connects up to 16 RMM2s for a total monitoring capacity of 128 temperatures.

Each temperature sensor connected to a RMM2 may have individual low- and high-temperature alarms. Alarm limits are set and alarm conditions are reported at the NGC-30 or NGC-40 control panel. Additional alarms are triggered for failed temperature sensors and communication errors. Alarms may be reported remotely through an alarm relay in the control system or through an RS-485 connection to a host computer supporting the Modbus protocol.

The RMM2 clips to a DIN 35 rail and can be mounted in a choice of enclosures, as required for the area classification and environment. For aggressive environments and Division 2 hazardous locations, nVent offers a glass-reinforced polyester TYPE 4X enclosure.

RTD's

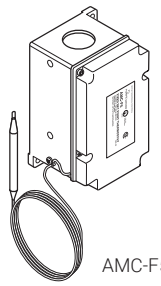


nVent RAYCHEM RTDs (Resistive Temperature Detectors) are used to sense ambient or line temperatures and provide feedback to the control device. A variety of RTD materials and form factor options provide solutions for all temperature-sensing requirements. Refer to the table below for product selection.

Table 11. RTD selection matrix

Catalog number	Maximum exposure	Approvals	Application
RTD-200	200°F (93°C)	Approval associated with control device. Not to be used in Division 1 hazardous locations.	Use when ambient RTD sensor is required.
RTD3CS	400°F (204°C)	Approval associated with control device. Not to be used in Division 1 hazardous locations	Used for pipes or tanks when controller is 3 feet or less from bulb placement. Use RTD extension wire/conduit (terminated in the appropriate enclosure for the area classification) to extend the lead wire to the required length. Not to be used for underground applications.
RTD10CS	400°F (204°C)	Approval associated with control device. Not to be used in Division 1 hazardous locations	Used for pipes or tanks when controller is 10 feet or less from bulb placement. Use RTD extension wire/conduit (terminated in the appropriate enclosure for the area classification) to extend the lead wire to the required length. Not to be used for underground applications.
RTD4AL	900°F (482°C)	CSA (U.S. & Canada) Class I, Div. 2, Groups A, B, C, D Class II, Div. 2, Groups F, G	Used for pipes and includes junction box to extend the lead wire to the required length using RTD extension wire/conduit.
RTD7AL	900°F (482°C)	CSA (U.S. & Canada) Class I, Div. 1, Groups C, D Class II, Div. 1, Groups E, F, G	Used for pipes and includes junction box to extend the lead wire to the required length using RTD extension wire/conduit.
RTD10	1100°F (593°C)	CSA (U.S. & Canada) Class I, Div. 1 & 2, Groups A, B, C, D Class II, Div. 1 & 2, Groups E, F, G Class III	Used for pipes or tanks when controller is 10 feet or less from bulb placement. Use RTD extension wire/conduit (terminated in the appropriate enclosure for the area classification) to extend the lead wire to the required length. Additional lengths are available; contact nVent for additional information.
RTD20	1100°F (593°C)	CSA (U.S. & Canada) Class I, Div. 1 & 2, Groups A, B, C, D Class II, Div. 1 & 2, Groups E, F, G Class III	Used for pipes or tanks when controller is 20 feet or less from bulb placement. Use RTD extension wire/conduit (terminated in the appropriate enclosure for the area classification) to extend the lead wire to the required length. Additional lengths are available; contact nVent for additional information.
RTD4AL-EP	900°F (482°C)	CSA (U.S. & Canada) Class I, Div. 2, Groups A, B, C, D Class II, Div. 2, Groups F, G	Used for pipes and includes junction box to extend the lead wire to the required length using RTD extension wire/conduit. The RTD4AL-EP is epoxy coated to provide added corrosion resistance.
RTD4AL-SS	900°F (482°C)	CSA (U.S. & Canada) Class I, Div. 2, Groups A, B, C, D Class II, Div. 2, Groups F, G	Used for pipes and includes junction box to extend the lead wire to the required length using RTD extension wire/conduit. The RTD4AL-SS has a 316SS sensor housing and sheath.
RTD7AL-SS	900°F (482°C)	CSA (U.S. & Canada) Class I, Div. 1, Groups C, D Class II, Div. 1, Groups E, F, G	Used for pipes and includes junction box to extend the lead wire to the required length using RTD extension wire/conduit. The RTD7AL-SS has a 316SS sensor housing and sheath.

Ambient Sensing Thermostats

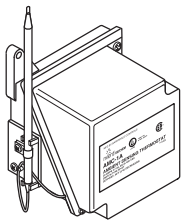


AMC-F5

These thermostats are used to control heating cable circuits in freeze protection applications. When the outdoor temperature drops below the set point, the thermostat switches on. Control multiple circuits by connecting the thermostat to the coil of a contactor.

AMC-F5

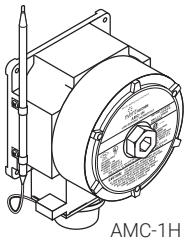
This thermostat has a fixed set point of 40°F (5°C) and is used for freeze protection applications in either an ambient or line sensing configuration. The SPST switch, rated 480 Vac, 22 A, is enclosed in a plastic TYPE 4X enclosure. The tin-plated copper sensor assembly is 30 inches long. The unit is UL Listed and CSA certified for use in nonhazardous locations. Select this low-cost thermostat for areas not subject to mechanical abuse.



AMC-1A

AMC-1A

This thermostat has an adjustable set point between 15°F and 140°F (–9°C and 60°C) and is used for freeze protection applications. The TYPE 4X enclosure is coated cast aluminum with stainless steel hardware. The switch is rated 480 Vac, 22 A. The stainless steel sensor assembly is permanently mounted to the enclosure. The unit is UL Listed and CSA certified for use in nonhazardous locations. Select this thermostat where set-point adjustment or mechanical ruggedness is important.

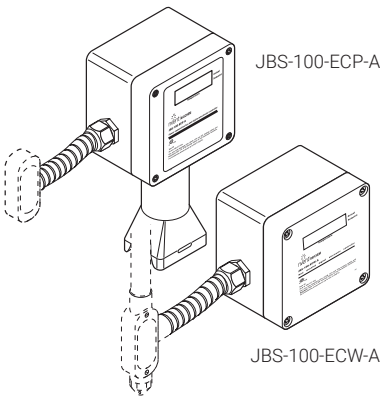


AMC-1H

AMC-1H

This is the hazardous location–approved version of the AMC-1A. It includes a TYPE 4, 7, 9 coated cast-aluminum enclosure and is approved by FM, UL Listed, and CSA certified for use in Division 1 and 2 hazardous locations. Select this thermostat when the control unit must be located in a hazardous location.

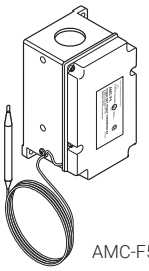
Line Sensing Thermostats



These thermostats are used to control heating cable circuits used in freeze protection and process-temperature maintenance applications. All can be used to switch a heat-tracing circuit directly or switch the coil of a contactor. Those with adjustable set points can be used instead to indicate low- or high-temperature alarm conditions.

JBS-100-ECP-A and JBS-100-ECW-A

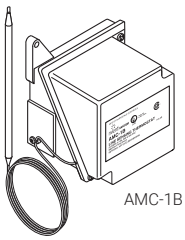
The JBS-100-ECP-A and JBS-100-ECW-A are electronic temperature controllers that provide accurate control of a heating circuit using a RTD sensor. The JBS-100-ECP-A is pipe mounted and serves as a power connection kit for self-regulating, power-limiting and mineral insulated heating cables. The JBS-100-ECW-A is wall mounted and may be used with all types of heating cables. The JBS-100-ECW-A can only be used as a power connection with mineral insulated cables. Combining the power connection and controller into one single unit will significantly reduce installation cost. Both the JBS-100-ECP-A and JBS-100-ECW-A have adjustable set points between 32°F to 425°F (0°C to 218°C), power input of 120 Vac to 277 Vac, and switch currents of up to 30 A. A local display allows for monitoring of set point, actual temperature, and also indicates alarm conditions (high/low temperature and sensor failure). A form C contact allows for remote annunciation of alarms. These units are c-CSA-us (certified to U.S. and Canadian Standards) for use in nonhazardous locations.



AMC-F5

AMC-F5

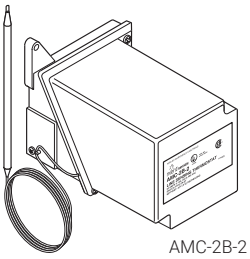
This low-cost thermostat has a fixed set point of 40°F (5°C) and is used for freeze protection. The SPST switch, rated 480 Vac, 22 A, is enclosed in a plastic TYPE 4X enclosure. The tin-plated copper sensor assembly is 30 inches long. The unit is UL Listed and CSA certified for use in nonhazardous locations. Select this low-cost thermostat when using ambient or line sensing control for freeze protection in areas not subject to mechanical abuse.



AMC-1B

AMC-1B

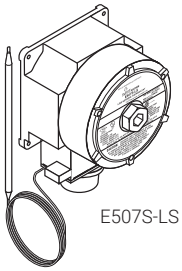
This thermostat has an adjustable set point between 25°F and 325°F (–4°C and 163°C). The TYPE 4X enclosure is coated cast aluminum with stainless steel hardware. The SPDT switch is rated 480 Vac, 22 A. The stainless steel sensor assembly is 9 ft (3 m) in length. The unit is UL Listed and CSA certified for use in nonhazardous locations. Select this thermostat where set point adjustment or mechanical ruggedness is important.



AMC-2B-2

AMC-2B-2

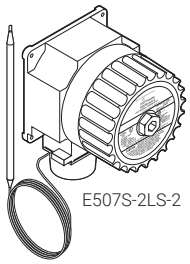
This is the two-pole version of the AMC-1B. It has an adjustable setpoint between 25°F and 325°F (–4°C and 163°C). The control switch in this thermostat opens both heat-tracing circuit power wires. Select this thermostat when local safety standards require that both phases be switched in phase-to-phase supplies such as 208 and 240 Vac. The unit is UL Listed and CSA certified for use in nonhazardous locations. Select this thermostat where set point adjustment or mechanical ruggedness is important.



E507S-LS

E507S-LS

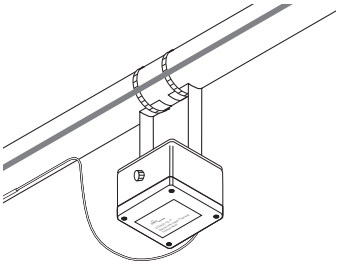
This is the hazardous location–approved version of the AMC-1B. It has an adjustable setpoint between 25°F and 325°F (–4°C and 163°C). It includes a TYPE 4, 7, 9 coated cast-aluminum enclosure and is approved by FM, UL Listed, and CSA certified for use in Division 1 and 2 hazardous locations. Select this thermostat when the control unit must be located in a hazardous location.



E507S-2LS-2

E507S-2LS-2

This is the two-pole version of the E507S-LS. It has an adjustable setpoint between 25°F and 325°F (–4°C and 163°C). The control switch in this thermostat opens both heat-tracing circuit power wires. Select this thermostat when local safety standards require that both phases be switched in phase-to-phase supplies such as 208 and 240 Vac. It includes a TYPE 4, 7, 9 coated cast-aluminum enclosure and is approved by FM, UL Listed, and CSA certified for use in Division 1 and 2 hazardous locations. Select this thermostat when the control unit must be located in a hazardous location.



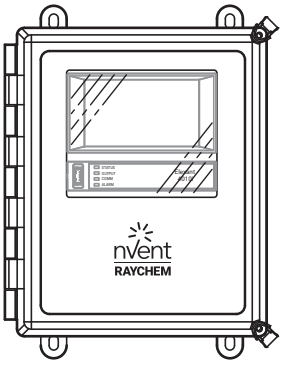
ETS-05

The nVent RAYCHEM ETS-05-XX-A electronic surface sensing thermostat provides accurate temperature control for heating cables.

The ETS-05-XX-A is available in two versions. The ETS-05-L2-A is for temperatures up to 199°C (390°F), while the ETS-05-H2-A can be used for temperatures up to 499°C (930°F).The maximum nominal load is 24 A for both thermostats. Temperature setting is accurate via digital rotary switches inside the enclosure.

These electronic systems are designed to control heating-cable circuits used in freeze protection and process-temperature maintenance applications. Each has unique features that provide cost-effective temperature control and extensive heat-tracing circuit integrity monitoring. All offer digital displays, simple push-button configuration, and intelligent communications to remote PCs or a DCS. Choose the Elexant 4010i for single heat-tracing circuits, the 920 or the Elexant 4020i for specialty or lower circuit counts, or the NGC-30 or NGC-40 for multiple heat-tracing circuits.

Single and Dual-Point Control and Monitoring Systems



Elexant 4010i Controller

The nVent RAYCHEM Elexant 4010i is a compact, full-featured, touch screen based, single-point heat-tracing controller. It provides control and monitoring of Electric Heat Tracing (EHT) circuits for both freeze protection and process temperature maintenance. This controller can monitor and alarm on high and low temperature, high and low current, ground-fault levels, voltage, and supports a host of additional features to offer the utmost in control and monitoring of EHT.

The Elexant 4010i controller is available in two output types: an electromechanical relay (EMR) for use in nonhazardous locations, and a solid-state relay (SSR) for use in nonhazardous and Class I Div. 2 / Zone 2 hazardous locations. The controller is protected by a Fiber reinforced plastic or Stainless steel enclosure, both with front window (-FW or -SW). Multiple communication ports allow flexible connectivity for remote monitoring, configuration, and ease of integration with nVent RAYCHEM Supervisor software or a Distributed Control System (DCS).

Control

The Elexant 4010i measures temperatures of up to three directly- connected temperature sensors. The controller also supports 4-20 mA inputs, allowing the use of external temperature sensor converters with thermocouples or other sensor types. The Elexant 4010i also features line sensing, ambient sensing, Proportional Ambient Sensing Control (PASC), and power limiting modes.

Monitoring

A complete set of parameters are measured, including ground fault, temperature, current and voltage to ensure system integrity. The controller can be set to periodically check the heating cable for faults, alerting maintenance personnel of a heat-tracing problem eliminating costly manual maintenance checks.

A programmable dry contact alarm relay is provided for local or remote alarm annunciation.

Ground-Fault Protection

National electrical codes require ground-fault equipment protection on all heat-tracing circuits. The Elexant 4010i controllers incorporate ground-fault sensing with alarm, and trip functionality. Internal self-tests are automated, eliminating the need for manual testing. Heat-tracing circuits equipped with Elexant 4010i controllers do not require additional ground-fault detection equipment, simplifying installation and reducing costs.

Installation

The Elexant 4010i comes ready to install, eliminating the need for custom panel design or field assembly. The NEMA 4X/IP6x-rated FRP or stainless steel enclosures are approved for use in both indoor and outdoor locations. Wiring is as simple as connecting the incoming and outgoing power wiring (up to 277 Vac) and temperature sensors as needed for the application.

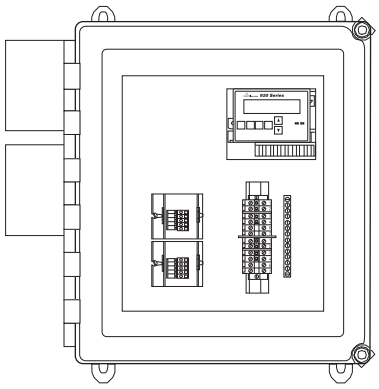
The Elexant 4010i provides an intuitive user interface that makes it easy to use and program. No additional programming devices are needed. Alarm conditions and programming settings are easy to read and interpret on the color touch screen. Settings are stored in non-volatile memory in the event of a power failure.

Communication

Elexant 4010i units come equipped with RS485 and Ethernet ports and can be readily connected to a distributed control system (DCS).

The units support both the Modbus RTU and Modbus/TCP protocols. The controller may be networked to a host PC running Windows-based nVent RAYCHEM Supervisor software for central programming, status review, and alarm annunciation.

Elexant 920 Series Controller



The nVent RAYCHEM 920 is a compact, full-featured, microprocessor-based, dual-point heat-tracing control system.The 920 provides control and monitoring of two independent electrical heat-tracing circuits for both freeze protection and temperature maintenance, and can be set to monitor and alarm for high and low temperature, high and low current, ground-fault level, and voltage on each of its control points. The nVent RAYCHEM 920 controller is available with two output types: an electromechanical relay (EMR) for use in nonhazardous locations and a solid-state relay (SSR) for use in nonhazardous and Class I Div. 2/Zone 2 hazardous locations. Communications modules are available for remote control and configuration, complete with nVent RAYCHEM Supervisor software capability

Control

The nVent RAYCHEM 920 measures temperatures with 3-wire 100-ohm platinum RTDs connected directly to the unit. Up to two RTDs are supported for each of the two control points. The controller may be used in line-sensing, ambient-sensing, proportional ambient-sensing, and power-limiting modes.

Monitoring

A variety of parameters are measured, including ground fault, temperature, and current to ensure system integrity. The system can be set to periodically check the heating cable for faults, alerting maintenance personnel of a heat-tracing problem.
A dry contact relay is provided for alarm annunciation back to a distributed control system (DCS).

Ground-fault protection

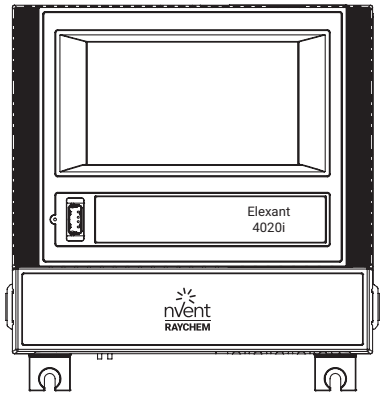
National electrical codes require ground-fault equipment protection on all heat-tracing circuits. The nVent RAYCHEM 920 controllers incorporate the ground-fault sensing, alarm, and trip functionality internally. Heat-tracing circuits equipped with nVent RAYCHEM 920 controllers do not require additional ground-fault detection equipment, simplifying installation and reducing costs.

Installation

The standard nVent RAYCHEM 920 unit comes ready to install right from the box, eliminating the need for custom panel design or field assembly. Custom configurations are also available from the factory to allow the user to tailor the solution to the application. The TYPE 4X-rated FRP or optional stainless steel enclosures are approved for use in indoor and outdoor locations. Wiring is as simple as connecting the incoming and outgoing power wiring (up to 600 Vac) and an RTD. The nVent RAYCHEM 920 operator console includes LED displays and function keys that make it easy to use and program. No additional handheld programming devices are needed. Alarm conditions and programming settings are easy to interpret on the full-text front panel. Settings are stored in nonvolatile memory in the event of power failure.

Communications

nVent RAYCHEM 920 units may be networked to a host PC running Windows®-based nVent RAYCHEM Supervisor software for central programming, status review, and alarm annunciation. nVent RAYCHEM 920 units support the Modbus® protocol and may be ordered with an RS-485 communications interface.



Elexant 4020i Controller

The nVent RAYCHEM Elexant 4020i is a compact, full-featured, touch screen based, single-point heat-tracing controller. It provides control and monitoring of Electric Heat-Tracing (EHT) circuits for both freeze protection and process temperature maintenance. This controller can monitor and alarm on high and low temperature, high and low current, ground-fault levels, voltage, and supports a host of additional features to offer the utmost in control and monitoring of EHT.

The Elexant 4020i controller provides three output types: a line powered relay for driving contactors in nonhazardous locations; a DC output for driving solid-state relays (SSRs) in nonhazardous and Class I Div. 2 / Zone 2 hazardous locations; and a 0-10V analog output for driving variable output power modules. Multiple communication ports allow flexible connectivity for remote monitoring, configuration, and ease of integration with nVent RAYCHEM Supervisor software or a Distributed Control System (DCS).

Control

The Elexant 4020i measures temperatures for up to three directly-connected temperature sensors. The controller also supports4-20mA inputs, allowing the use of external temperature sensor converters with thermocouples or other sensor types. The Elexant 4020i also features line sensing, ambient sensing, Proportional Ambient Sensing Control (PASC), and power limiting modes.

Monitoring

A complete set of parameters are measured, including ground fault, temperature, current, and voltage to ensure system integrity. The system can be set to periodically check the heating cable for faults, alerting maintenance personnel of a heat-tracing problem eliminating costly manual maintenance checks. A programmable dry contact alarm relay is provided for local or remote alarm annunciation. No safety limiter offered for NA currently.

Ground-Fault Protection

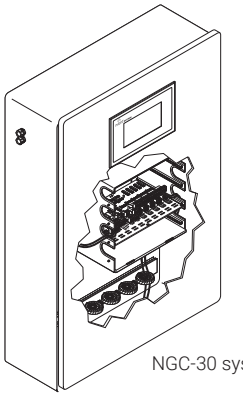
National electrical codes require ground-fault equipment protection on all heat-tracing circuits. The Elexant 4020i control modules incorporate ground-fault sensing with alarm and trip functionality. Internal self-tests are automated, eliminating the need for manual testing. Heat-tracing circuits equipped with Elexant 4020i controllers do not require additional ground-fault detection equipment, simplifying installation and reducing costs.

Installation

The Elexant 4020i comes ready to install into an enclosure appropriate for the intended environment. The modules are available in standard multi-circuit panels suitable for indoor or outdoor locations, and custom configurations are available to provide the most flexible solution. Installing is as simple as connecting the incoming and outgoing power wiring and temperature sensors as needed for the application. The Elexant 4020i provides is an intuitive user interface that makes it easy to use and program. No additional programming devices are needed. Alarm conditions and programming settings are easy to read and interpret on the color touch screen. Settings are stored in non-volatile memory in the event of a power failure.

Communication

Elexant 4020i units come equipped with RS485 and Ethernet ports and can be readily connected to a distributed control system (DCS). The units support both the Modbus RTU and ModBus/TCP protocols. The controller may be networked to a host PC running Windows-based nVent RAYCHEM Supervisor software for central programming, status review, and alarm annunciation.



NGC-30 system

NGC-30 System

The NGC-30 system is a next generation heat-tracing control and monitoring system using state-of-the-art electronics and a touch screen user interface terminal to reduce training and greatly increase ease of use. Able to control up to 260 heat-tracing circuits, the NGC-30 provides independent circuit monitoring, programming and fault reporting for maximum system flexibility. Faults and alarms are communicated in plain text via the touch screen user interface terminal, enhancing usability and reducing troubleshooting time.

Compatible with Ethernet, RS-485 and RS-232 communications, the NGC-30 system can be easily integrated into existing plant networks. Supervisor software can be used to provide remote or centralized access to the NGC-30 System and establish a stand-alone heat-tracing control point. The NGC-30 communicates to external systems via the Modbus protocol if compatibility with existing DCS systems is desired.

The NGC-30 is available with both electromechanical or solid-state relays and is approved for both hazardous and nonhazardous locations.

Control

The NGC-30 measures temperatures with 3-wire, 100-ohm platinum RTDs. The temperature information can be transferred to the NGC-30 control panel through an RTD directly connected to the NGC-30 panel, or through an optional nVent RAYCHEM Remote Monitoring Module RMM2. Each RMM2 aggregates up to 8 RTDs in the field. The RMM2 module communicates temperature data back to the NGC-30 system via a single RS-485 twisted wire pair.

Monitoring

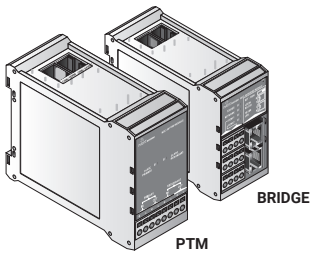
The NGC-30 system measures 12 parameters including ground-fault, temperature and current variables to ensure system integrity. The NGC-30 units can monitor up to 16 RMM2s that each have inputs for eight temperature sensors (RTD). The RMM2s can be connected by a single RS-485 cable to the NGC-30, thus reducing wiring costs for temperature sensors. Three (3) dry contact alarm relays are provided for remote alarm indications if desired. The system allows configuration of what fault types cause relay state change. For example, one relay could be configured to indicate only when a ground-fault alarm exists, another only in response to a temperature alarm and the third for over current and communications and RTD sensor failures. The system can be set to periodically check for heating cable faults when conditions do not require the heat tracing to be energized for extended periods. If a problem occurs, maintenance personnel will be notified and the issue can be repaired before it effects plant operation.

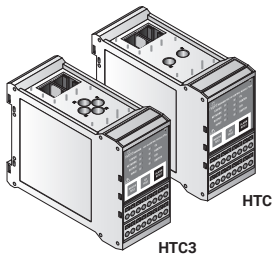
Benefits and Features

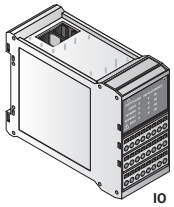
- Optimized control mode for each individual heat-tracing circuit. Each of the 260 heat-tracing circuits can be set to one of five control algorithms independently of the setting of any other heat-tracing circuits. There are no global settings at the circuit level
- Central status overview and access to all parameters of the entire heat-tracing installation through the touch screen user interface terminal. This intuitive interface reduces training time and provides simple and easy navigation so that maintenance and operations personnel can retrieve the information they need quickly and without bulky reference manuals
- Faults are communicated in plain language eliminating the need to remember or decipher fault codes
- Alarms for temperatures, ground-fault currents, operating currents, communications, RTD status and others are all logged in an Events file to track system history. Information is easily accessible through the user interface terminal which also provides the ability to sort on the various fault types
- Ground-fault alarm and trip thresholds are independently programmable to allow warning of a potential problem before a system shut-down is implemented. This allows the heat-tracing system to be checked at a convenient time with minimal impact to plant operations and hardship to personnel
- Significant cost savings through distributed architecture and reduced RTD wiring (using the RMM2). Temperature input and control output modules can be placed at a convenient location
- Supervisor client-server software allows heat-tracing control to become an integral part of your Heat Management System. This software provides information and configuration capability at one central location making better use of personnel. Data logging for trending, fault finding and other analysis allows predictive maintenance when using the Supervisor client-server software including automatic heat-tracing system integrity checks and many more features
- LAN/WAN access allows control and monitoring from any location worldwide

Other Features

- Passwords provide various levels of access for different user groups. This allows all necessary status and monitoring information to be viewed by anyone but restricts temperature setpoint and fault threshold changes to certified personnel
- Rack mountable control cards are easily added and removed from the NGC-30 system panel. This allows fast and easy replacement in the case of a failure or the ability to expand the system as your facility grows







NGC-40 system

The NGC-40 is an advanced, electronic, single-point control, monitoring and power distribution system in a multipoint industrial heat-tracing panel. The single control module per heat-tracing circuit provides the highest reliability architecture for heat-tracing applications. The NGC-40 single-controller architecture ensures that problems occurring with one heat-tracing system stay isolated without affecting the other circuits. The advanced User Interface with touch screen technology simplifies local programming and monitoring through intuitive menus and full text alarm reporting.

The NGC-40 supports up to 80 circuits and provides maximum flexibility through its modular architecture to meet any need at an optimized cost. The NGC-40 is available with two output types: an electromechanical relay (EMR) or a solid state relay (SSR). The system is fully flexible from a configuration point of view and offers individual single-phase and three-phase electrical heat-tracing controllers.

The NGC-40 is supported by the innovative Touch 1500, a 15-inch color touch screen user interface which provides plant personnel with local, intuitive access to the complete control and monitoring system. The Touch 1500 allows for status, alarm and event monitoring of the heat-tracing circuits as well as the easy adjustment of the control and monitoring system to handle revised heat-tracing system configurations.

Full compatibility with the Supervisor software allows not only control and monitoring but also data logging for trending, fault finding and other analysis allows predictive maintenance.

Control

The NGC-40 measures temperatures with 3-wire, 100-ohm platinum RTDs, 2 or 3-wire, 100-ohm nickel iron RTDs, or 2-wire, 100-ohm nickel RTDs. The temperature information may come from a single, direct RTD hard-wired to the NGC-40 control panel, from a local NGC-40 IO module, or from a remote source such as an RMM2 module. Up to eight (8) Resistance Temperature Devices (RTDs) can be used for each heat-tracing circuit allowing a variety of temperature control, monitoring, and alarming configurations. For RTD selection, see Table 11 Selection Matrix.

Monitoring

The NGC-40 system measures a variety of parameters including ground-fault, temperature and load current(s) to ensure system integrity. In the case of three-phase heaters, the current of each phase can be separately measured and monitored. The system can be set to periodically check the heating cable for faults, alerting maintenance personnel of a pending heat-tracing problem, and avoiding costly downtime.

Features

- Each circuit is controlled by individual single-phase or three-phase controllers.
- Control and monitoring of up to 80 individual circuits per panel with multiple panels connected to one Touch 1500 user interface
- The NGC-40 system is configured with an optional Touch 1500 user interface, that is a state-of-the-art 15-inch color display with touch screen technology for monitoring and configuration purposes. The Touch 1500 touch screen allows convenient user access on site to all heat-tracing circuits and provides an easy user interface for programming without keyboards or cryptic labels
- The Touch 1500 can be installed either locally on the panel door or in a remote location and communicates to the NGC-40 heat-tracing controllers via Ethernet or an RS-485 serial interface
- I/O modules allow additional temperature and analog/digital signals to interface with the control modules. Up to 8 RTDs can be assigned to one heat-tracing circuit
- Each NGC-40 control module (HTC, HTC3) and I/O module provides one programmable multi-purpose digital input for connection to external dry (voltage-free) contact or DC voltage
- A dry contact relay per control module and a common alarm is available for alarm annunciation back to a Distributed Control System (DCS). Alternatively, the NGC-40 system can report alarm and monitoring data directly to the DCS via Modbus
- Many heat-tracing related control algorithms are available such as ON/OFF, ambient sensing, PASC (Proportional Ambient Sensing Control) and proportional control (if used with solid state relays)
- The NGC-40 control modules operate independently from the user interface touch screen (TOUCH 1500) for increased system reliability. A failure of the TOUCH 1500 will not cause the heat-trace controllers to stop controlling the load
- NGC-40 is designed for easy installation and requires minimal wiring on site. All NGC-40 units are packaged in DIN rail mount housings, suitable for installation onto symmetric 35 mm DIN rails. Panel wiring is minimized by using internal network
- Alarm Output: Each controller monitors and alarms on high or low temperature, load current and ground-fault alarm and trip points set at user defined levels. As required by the NEC and CEC, as an Equipment Protection Device, the controller switches all hot legs of a circuit for ground fault interruption
- When using solid-state relays, power and current control maybe be used on heat-tracing circuits to reduce inrush currents and nuisance circuit breaker trips
- Autocycling: The controller will momentarily energize the heat tracing at a user set interval and provide feedback if there are any problems with the heat trace. Circuit alarms will be generated as the fault occurs thereby reducing costs of preventative maintenance
- The Supervisor software package provides a remote, graphic interface for the NGC-40. The software allows the user to configure and monitor various NGC systems from a central location. Supervisor provides various levels of access for different user groups

Benefits

- Individual circuit control by single circuit controllers provides highest reliability architecture for critical heat tracing circuits
- Strategic location of the optional Touch 1500 user interface linked to a group of heat-tracing panels leads to optimize maintenance activities
- The touch screen interface (Touch 1500) provides local, easy, intuitive access to configuration, status, alarms and events for the heat-tracing system
- Maximum flexibility in heat-tracing control design by using the innovative data sharing among the heat tracing circuits within a panel, as well as, the programmable digital inputs and alarm outputs of each control module
- Modular System provides maximum flexibility to meet any need at an optimized cost. Individual control and standard communication wiring leads to flexible and optimized panel design to customer requirements
- Availability of multiple control algorithms leads to the most optimized heat-tracing solution by minimizing the energy consumption and installation cost
- Permanent supervision of the integrity of the heat-tracing circuit and detailed problem reporting simplifies maintenance and increases personnel safety
- Control of inrush currents leads to the reduction of panel power requirements and therefore significant savings on power distribution costs
- Controls and monitors any type of heat-tracing cable

SOFTWARE

nVent RAYCHEM Pipeline Supervisor

The nVent RAYCHEM Pipeline Supervisor (RPS) software has a uniquely configured Graphic User Interface built on an agnostic platform using custom, complex algorithms in order to be able to monitor and analyze any pipeline length or sensitive temperature fluid. The software takes the DTS (Distributed Temperature Sensing) data from a fibre optic sensor on a pipeline and analyzes it to essentially create a “stethoscope” on the pipeline to see what is happening in real-time, (e.g., temperature, phase change status, re-melted zones, rupture detection). Using the data, RPS creates “actionable” tasks and “alerts” for operations & maintenance personnel that are data driven while providing advance warning of heater performance degradation, or pipeline operations outside of normal parameter.

In addition to the many performance features, RPS offers many user benefits:

- Allows access to critical pipeline heating and temperature status remotely via Tablet, iPad, Smartphone, remote PC, etc.
- Configured for your specific pipeline service and operational design parameters
- Enhanced operational insights and confidence combined with a deeper understanding of actionable tasks
- Historical trending analysis for increased operational transparency
- Detailed analytics to help create a safer facility for both employees and society
- Controlled login access and software permissions for each team member
- End-to-end services support framework for seamless integration and performance

Features by Tiered Grouping

	nVent RAYCHEM Pipeline Supervisor	Select	Premium
1	Multiple Pipeline Asset Monitoring Functionality	√	√
2	Sensing Fiber Attenuation Profile	√	√
3	Complete Pipeline Temperature Profile w/ Color Gradients	√	√
4	Critical Alarm Management	√	√
5	Automated Data Backup	Manual	√
6	Historical Time Trending Analysis (Temperature)	√	√
7	Enhanced Configurable GUI	√	√
8	DTS System Health	√	√
9	Configurable Alarm Latching	√	√
10	Role Based Permissions / Access	√	√
11	Multiple Delivery Platforms (Tablet & Mobile Phone Access)	√	√
12	Email / Text Alerts / Notifications (internet access required)	√	√
13	Real-Time Pipeline Health Gauge (based on key metrics)		√
14	Insulation Health Monitoring		√
15	Site Asset Landmark Mapping		√
16	RTD vs DTS 2-way Validation		√
17	Shift Summary Report		√
18	“Time to Freeze” Prediction		√
19	Anchor Health Monitoring		√
20	Pipeline Profile vs Plan View Toggling		√

The above offering is illustrative and may be modified by nVent from time to time with prior notification to Client.

New functionalities, features and/or modules developed by nVent may be assigned by nVent, in its sole discretion, to the Select Offer, the Premium Offer, or to a new Offer category, which nVent reserves the right to create.

√ – Features will be launched in the near future.

System Requirements, Hardware and Connectivity

nVent RAYCHEM Pipeline Supervisor is designed on a platform that works with both on-premise and Cloud solutions, which backs-up all measurement and alarm data on a hard-drive. The most recent 2 weeks of data will be available for viewing in the software dashboard. The browser-based user interface allows for access through multiple devices including smart phones, tablets and remote PC's.

The system and hardware requirements vary slightly from project to project, and are dependent on the customer's unique system requirements. All on-premise solutions are delivered as a combination of a local server and the RPS software. The server is rack mounted and installed with an industrial PC, monitor and keyboard for stand-alone access to the software (communication is Modbus RTU protocol via TCP/IP, RS-232, or RS-485). The solution allows for multi-users in different locations as well as remote access, provided the solution is setup on a Control Network (or corporate network if desired).

nVent RAYCHEM Pipeline Supervisor can be installed on new pipelines, or retrofitted to existing temperature-critical pipelines with the combination of Distributed Temperature Sensing (DTS) and Electrically Heat Traced (EHT) pipelines.

Software Services and Support

- Software configuration including site asset landmark mapping and unique user access parameters
- Installation, commissioning and training
- DTS diagnostics and performance review
- Multi-level technical support
- Updates and upgrades using multiple delivery options
- Alarm log history review and refinement
- User access and permission level control / approval

Software Data Protection

- Follow current industry standards and have technical and organizational safeguards in place to protect the confidentiality, integrity, and availability of data
- We protect data against unauthorized access, use or disclosure, using security technologies and procedures, such as encryption and access controls and limitations
- Measurement and alarm data is backed up on a removable hard drive, and the most recent 2 weeks of data will is available for viewing in the software dashboard
- Apply processes and technologies to help prevent nVent RAYCHEM Pipeline Supervisor from containing viruses or any other contaminants that access (without authorization) or shut down computer systems, networks, software or other data or property (“Malware”)

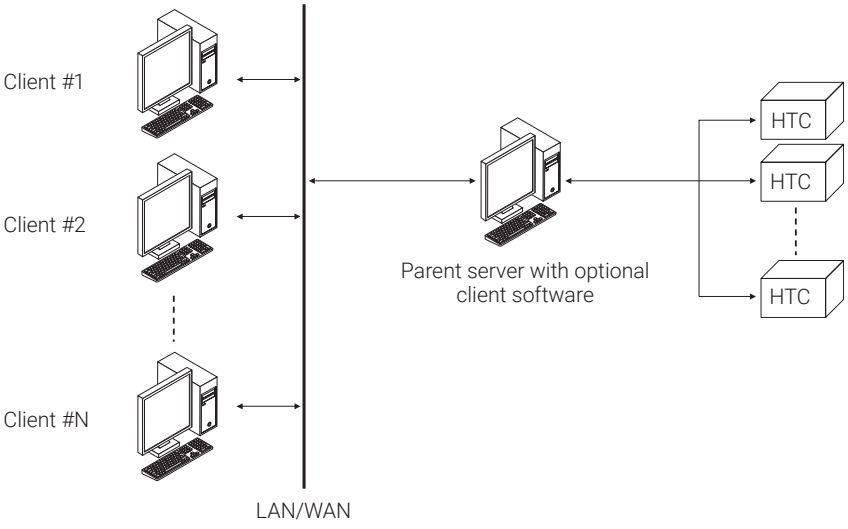
nVent RAYCHEM Supervisor

The nVent RAYCHEM Supervisor heat-tracing controller configuration and monitoring software provides a graphical user interface for nVent RAYCHEM heat-tracing communication and controller products. Heat-trace system information can be accessed and managed from almost anywhere in the world, making Supervisor a powerful management tool for the entire Heat Management System (HMS).

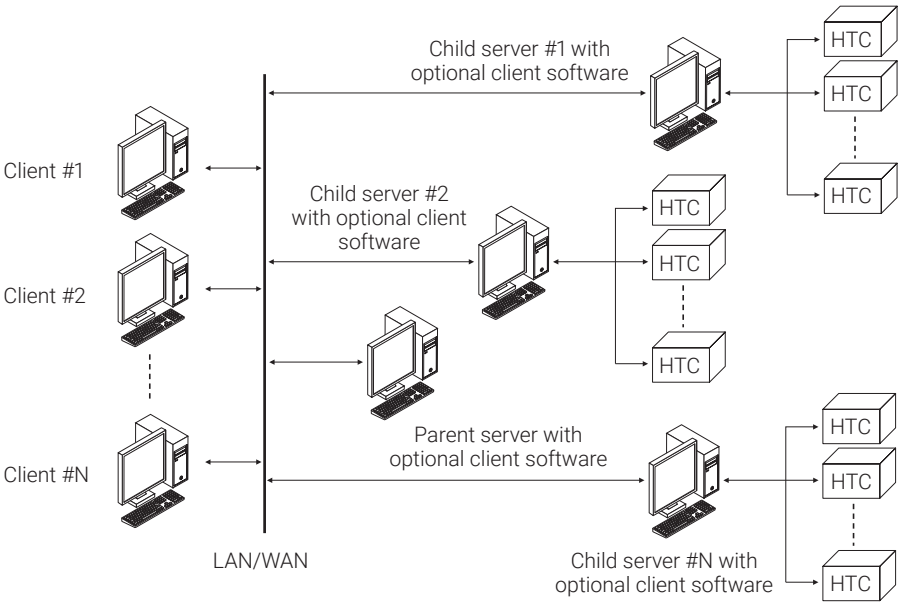
By using the latest network technologies, costs can be reduced. Devices are no longer limited to simple hard-wired serial communications, but take advantage of existing network infrastructures including Ethernet LANs (Local Area Networks) and Internet-based WANs (Wide Area Networks).

nVent RAYCHEM Supervisor is available in two Editions – 'Standard' and 'Enterprise'.

The standard edition is a single-server multi-user version. It provides connectivity to several hundred control units in the field and can support up to four simultaneous users:



The 'Enterprise' edition offers unlimited multi-user, multi-server network capabilities, expanding on the capabilities of the 'Standard' edition. Enterprise level functionality requires the purchase of SQL server software and Microsoft Licensing:



System considerations

All nVent RAYCHEM Supervisor EHT systems will have one Parent Server and at least one Client. These may be installed on the same hardware, or may be installed separately, depending on the topology of the system. For larger systems, one or more Child Servers may be added to distribute computing resources throughout a facility. Child Servers can also reduce installed cost by making interconnections easier and less expensive using an existing networking infrastructure.

In all cases, more than one user can access the Parent and/or Child Servers at the same time using the nVent RAYCHEM Supervisor Client software. The Parent Server and Child Servers will manage communications to field devices (HTCs, UITs, NGC-40 Bridges, and GCCs), and the user's plant data to provide multiple clients with up-to-date information. In order to achieve this, the Parent and Child Servers must be running as efficiently as possible.

The efficiency of your nVent RAYCHEM Supervisor EHT system is directly related to how your plant data is organized. An EHT system that is well organized will run consistently and efficiently. End users will be able to navigate easily through the plant setup and get to the information they need quickly.

Features & Benefits

- Access and manage Electronically controlled Heat-Tracing system information from almost anywhere in the world
- Utilizes the latest in connectivity technologies
- Enables central configuration and monitoring of any nVent RAYCHEM electronic controller installed in the field that includes the appropriate communications interface
- Full featured alarm monitoring with the ability to acknowledge and clear alarms
- Advanced features such as data logging and trending, batch and recipe processing, scheduled events, and more
- Scalable to meet the size of any installation
- Multi-user, multi-server networking capabilities
- Flexibility that reduces the cost of installing communications for electronic controllers within a facility
- Leverages existing network infrastructures such as Ethernet LANs (Local Area Networks) and Internet-based WANs (Wide Area Networks) to remove the limitations of simple hard-wired serial communications

Product Support	•• = Full or Enhanced Support • = Limited Support	Standard Edition	Enterprise Edition
	Elexant 4000 Series Controllers	••	••
	NGC-40 Bridge, HTC, HTC3 controllers and I/O modules	••	••
	NGC-20 Controllers	••	••
	NGC-UIT/UIT2, NGC-30 Controllers	••	••
	910/915/920 Series Controllers	••	••
	T2000 Series Controllers	••	••
	Legacy Devices (780/GCC, 720/790/ -9000/-CAS/-9100 HTCs)	••	••
HTC Connectivity			
	Serial (RS-232, RS-485)	••	••
	Ethernet	••	••
	Wireless / Radio	••	••
	Support for extended addressing	••	••
	Unique Communications Settings per Device	••	••
System Features			
	Multi-Level security	••	••
	System Management by Plant Group	••	••
	Product Configuration	••	••
	Real-time Monitoring	••	••
	Alarm Scanning/Logging	••	••
	Individual User-defined Preferences	••	••
	Multi-Level Device Alarm Priorities	••	••
Data Management			
	Enhanced Documentation	••	••
	Drawing Viewer	••	••
	Data Logging & Trending	••	••
	Data Import/Export	••	••
	Visual and Printed Reports	••	••
	Database Utilities	••	••
	History Logging	••	••
	System-wide Data Synchronization	••	••
	Internal User Messaging	••	••
Automation			
	Batches	••	••
	Recipes	••	••
	Event Scheduler	••	••
	Email on Alarm	••	••
	Offline Modes	••	••
	Automated Steam-Out Feature	••	••
	Load-shedding (NGC product lines)	••	••
Networking			
	Multi-User Connections	•[1]	••
	Multi-Server Architectures		••
	Remote Connectivity (LAN/WAN+VPN)	••	••
	Administration Tools	••	••

1. Limited to 4 users (clients)

North America
Tel +1.800.545.6258
Fax +1.800.527.5703
thermal.info@nVent.com

Latin America
Tel +1.713.868.4800
Fax +1.713.868.2333
thermal.info@nVent.com

Our powerful portfolio of brands:
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