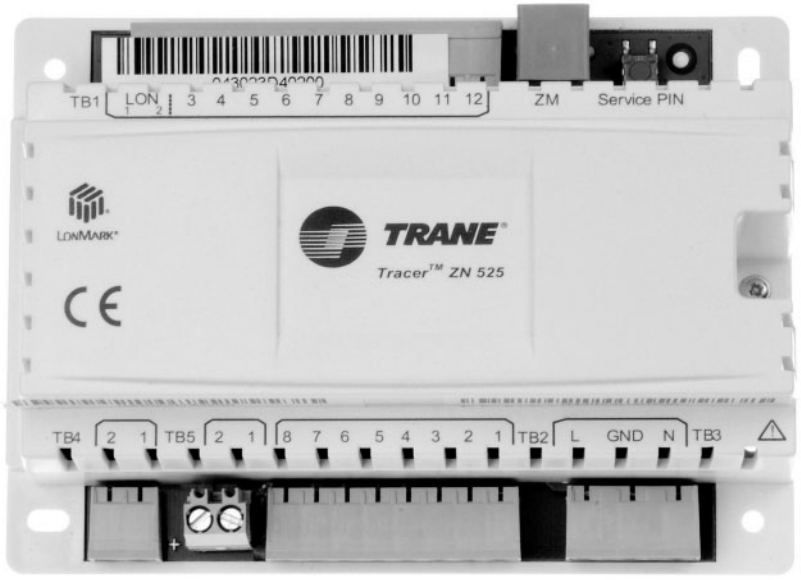
TRANE®

Cooling and Heating Systems a——vices

Tracer ZN525 Zone Controller



BAS-PRC030-E4

Introduction

Controller description

The ZN525 unit controller is a microprocessor-based direct digital controller that is dedicated to the control and the optimization of chilled water terminal units.

ZN525 is designed to provide improved comfort with minimum energy consumption.

It uses the measured space temperature as well as discharge air temperature (in cascade control mode) and a control algorithm maintains space temperature at the active setpoint while driving the fan at the lowest possible speed.

- LonMark® HVAC Space Comfort Controller profile 8501.
- Variable speed fan motor control capability.
- EC motor fan support.
- Supports various configuration: 2 pipes cooling only, 2 pipes heating only, 2 pipes change over, 2 pipes change over + electric heat, 2 pipes cooling + electric heat, 4 pipes, chilled beam.
- Cascade Proportional Integral control loop space / supply air temperature, or single PI control loop for low profile applications.
- 'Intelligent variable speed fan control for acoustic comfort and energy savings.
- Pre engineered Master / Slave capability for easy wall, floor arrangement changes.
- Automatic diagnostics control: sensor failure, freeze protection, condensate overflow, dirty filter.
- Designed for field and factory installation.
- Support of hot wax or 3 floating points valves actuators.
- Direct connection to fan (power supply and control signal).
- Direct control of electric heater (embedded relay with capacity of up to 1.8 kW).
- Capability of driving an external solid state relay for electric heater.
- Multiple mode of operation for occupancy conditions. (occupied / unoccupied / standby / bypass - timed override).
- PWM control of hot wax valves actuators (subject to qualification).
- PWM control of electric heater.
- Automatic changeover.
- Entering water temperature sampling in 2-way valves applications types.
- 230 Vac power supply.

When provided as a factory installed controller, ZN525 is setup and tested during the assembly process and is ready to run when delivered to the customer's site.
The use of a commissioning software, so called Trane Rover service tool, is required to adjust the various parameters of the controller, according to the application it is used for.

Contents

Inputs and outputs characteristics

ZN525 inputs and outputs include:

Binary inputs

Three binary inputs are available on ZN525. These inputs are designed for the following functions:

- Binary input 1: Occupancy
- Binary input 2: Window contact
- Binary input 3: Condensate overflow

Occupancy input

Occupancy input is used for two functions:

- Standalone controllers (Units not connected to a BMS over LonTalk®): The occupancy binary input determines the room occupancy. This input is typically connected to a motion sensor or clock. Occupied and unoccupied modes are supported in that case.
- Communicating controllers connected to a BMS over LonTalk®: The BMS sends requests for occupied / unoccupied mode. When in occupied mode, the ZN525 controller monitors the occupancy binary input as to select between occupied mode (Occupied is requested by the BMS AND there is somebody in the area) or occupied standby mode (Occupied is requested by the BMS but there is nobody in the area = Occupied, economy mode).

Table 1 - Normally Open Hardwired Occupancy Input Configuration

Description	Communicated request	Hardwired state	Result
Standalone	N/A	Open = Occupied	Occupied
Standalone	N/A	Closed = Unoccupied	Unoccupied
Communicating	Occupied	Open = Occupied	Occupied
Communicating	Unoccupied	Open = Occupied	Unoccupied
Communicating	Occupied Standby	Open = Occupied	Occupied Standby
Communicating	Occupied	Closed = Unoccupied	Occupied Standby
Communicating	Unoccupied	Closed = Unoccupied	Unoccupied
Communicating	Occupied Standby	Closed = Unoccupied	Occupied Standby

Table 2 - Normally Closed Hardwired Occupancy Input Configuration

Description	Communicated request	Hardwired state	Result
Standalone	N/A	Closed = Occupied	Occupied
Standalone	N/A	Open = Unoccupied	Unoccupied
Communicating	Occupied	Closed = Occupied	Occupied
Communicating	Unoccupied	Closed = Occupied	Unoccupied
Communicating	Occupied Standby	Closed = Occupied	Occupied Standby
Communicating	Occupied	Open = Unoccupied	Occupied Standby
Communicating	Unoccupied	Open = Unoccupied	Unoccupied
Communicating	Occupied Standby	Open = Unoccupied	Occupied Standby

Inputs and outputs characteristics

Window contact input

When the input indicates an opened window, the controller will disable fan operation, close all unit water valves and turn off any electric heat (when present).

Condensate overflow input

A condensate overflow signal will disable fan operation, close all unit water valves and turn off any electric heat (when present).
Condensate overflow diagnostic and discharge air temperature failure diagniostic are merged in the same diagnostic: Discharge air temperature failure. This contact is wired in parallel with the discharge air temperature sensor. When the condensate overflow is closed, the controller detects a short circuit on the discharge air temperature sensor input and generates a discharge air temperature failure diagnostic.

Table 3 - Binary input configurations

			Controller operations	
Binary input	**Description**	**Configuration**	**Contact close**	**Contact open**
BI 1	Occupancy	Normally Open	Unoccupied	Occupied
		Normally Close	Occupied	Unoccupied
BI 2	Window contact	Normally Open	Diagnostic*	Normal
		Normally Close	Normal	Diagnostic*
BI 3	Condensate overflow	Normally Open	Diagnostic*	Normal

*: see table 4

Table 4 - ZN525 controller diagnostics

		Controller operations					
Binary input	**Description**	**Fan**	**Cool valve**	**Heat valve**	**Electric heat**	**Diagnostic**	**Diagnostic type**
BI 1	Occupancy	-	-	-	-	-	-
BI 2	Window contact	Off	Close	Close	Off	Window contact	Informational
BI 3	Condensate overflow	Low speed	Close	Close	Off	Discharge air temperature failure	Non-latching

Inputs and outputs characteristics

Binary outputs

Six binary outputs are available on ZN525:

1 for fan motor power supply

2 for cooling valve actuator control

2 for heating valves actuator control

1 for electric heater control

See the following table for output assignments.

Analog output

One analog output is available on ZN525 (0..10V):

1 for fan motor speed control

Table 5 - ZN525 output assignment.

Description	Function	Terminals	2-pipe cooling only	2-pipe heating only	2-pipe change over	2-pipe cooling + electric heat (relay)	2-pipe cooling + electric heat (triac)	2-pipe change over + electric heat (relay)	2-pipe change over + electric heat (triac)	4-pipe	Chilled beam (cooling only)	Chilled beam (cooling only + electric heat)
Fan	Fan power supply	TB2-1	x	x	x	x	x	x	x	x		
	Fan neutral	TB2-2	x	x	x	x	x	x	x	x		
	Fan control signal	TB4-1	x	x	x	x	x	x	x	x		
	Fan control reference	TB4-2	x	x	x	x	x	x	x	x		
Cool valve 3-wire	Cool open	TB2-3	x		x	x	x	x	x	x	x	x
	Cool neutral	TB2-4	x		x	x	x	x	x	x	x	x
	Cool close	TB2-5	x		x	x	x	x	x	x	x	x
Heat valve 3-wire	Heat open	TB2-6		x						x		
	Heat neutral	TB2-7		x						x		
	Heat close	TB2-8		x						x		
Cool valve Hot wax	Cool open	TB2-3	x		x	x	x			x	x	x
	Cool neutral	TB2-4	x		x	x	x			x	x	x
Heat valve Hot wax	Heat open	TB2-6		x						x		
	Heat neutral	TB2-7		x						x		
Electric heat Relay	Electric heat	TB5-2				x		x				x
	Electric heat neutral	TB5-1				x		x				x
Electric heat Triac	Electric heat	TB2-6					x		x			x
	Electric heat neutral	TB2-7					x		x			x

Inputs and outputs characteristics

Analog inputs

Three analog inputs are available on ZN525.

Return air temperature / Local zone temperature (RAT)/ (ZT)

ZN525 needs a valid space temperature value for running its temperature control algorithms. When configured for using local zone temperature, the RAT/ZT analog input measures space temperature with a 10 kohms thermistor.

Entering water temperature (EWT)

ZN525 can be configured for using EWT to take changeover decisions or to report EWT information to the BMS.

In either case, EWT analog input must be wired up to a 10 kohms thermistor.

Discharge air temperature (DAT)

ZN525 measures DAT with a 10 kohms thermistor. This sensor is typically located downstream from the cooling/heating hydronic coils. DAT is used for maintaining discharge air temperature within comfort limits (discharge air tempering function).

In order to measure significant discharge air temperature, it is important to ensure that the discharge air sensor is located in the discharge air stream and there is enough airflow blown on the sensor.

Table 6 - Analog outputs characteristics

Analog input	Description	Sensor type	Range	Accuracy	Diagnostic
AI1	RAT / ZT	NTC 10 kohms	0 °C to 100 °C	+/- 0.2 °C	Space temperature failure
AI2	EWT	NTC 10 kohms	0 °C to 100 °C	+/- 0.2 °C	N/A
AI3	DAT	NTC 10 kohms	0 °C to 100 °C	+/- 0.2 °C	Discharge air temperature failure

Normal operations

ZN525 is an optimized controller for water terminal unit control application.

ZN525 focuses on maintaining comfortable room conditions for both temperature and sound level. It uses a unique control algorithm for fan control, maintaining fan motor to the lowest speed as possible.

Occupancy modes

Description

Occupancy modes can be indicated to ZN525 via the occupancy binary input or communicated from a building management system, 4 occupancy modes are controlled:

Occupied mode (or Comfort)

This is the normal operating mode for occupied spaces or daytime operation. This mode uses the occupied cooling and heating setpoints. The controller automatically selects the lowest fan speed (if in auto mode). The valve(cooling / heating) or the electric heater (if present) modulate to maintain the requested setpoint.

Unoccupied mode (or Antifreeze)

Normal operating mode for unoccupied spaces or night time. The controller attempts to maintain the space temperature at the unoccupied heating or cooling setpoint.

Occupied standby mode (or Economy)

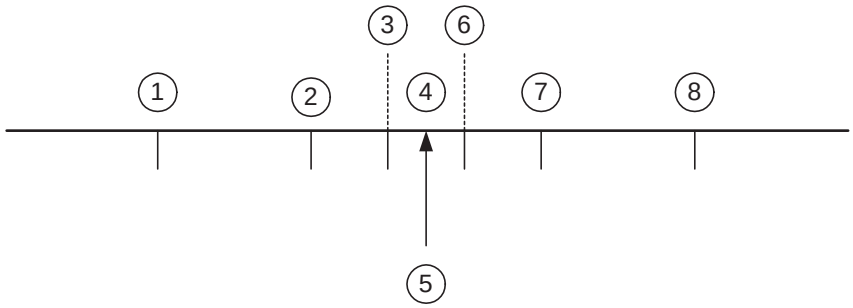
Mode used to reduce the heating and cooling operation during the occupied hours when the space is vacant or unoccupied. Setpoints are widened thus reducing energy consumption. This mode is only available in network and Building Management System configuration.

Occupied bypass mode (or Night Override)

Mode used for timed override conditions. In occupied bypass mode, the controller uses the occupied cooling and heating setpoints for 120 minutes (factory setting). This mode is selected when the communication request is 'unoccupied' or 'standby' and an occupant indicates his/her presence in the space controlled by the unit, either through a local zone sensor or via a time override request from the BMS.

Normal operations

Figure 1- ZN525 occupancy setpoints



1. Unoccupied heating setpoint
2. Occupied standby heating setpoint
3. Occupied heating setpoint
4. Dead band
5. Local setpoint
6. Occupied cooling setpoint
7. Occupied standby cooling setpoint
8. Unoccupied cooling setpoint

Benefits for owner

- Reduces energy consumption: Comfort level is set according to real zone occupancy status.

Benefits for end user

- Comfort at the right time.
- Timed override capability for 'extra hours' comfort control.

Benefits for operation manager

- Energy savings are optimized when the building is not occupied.

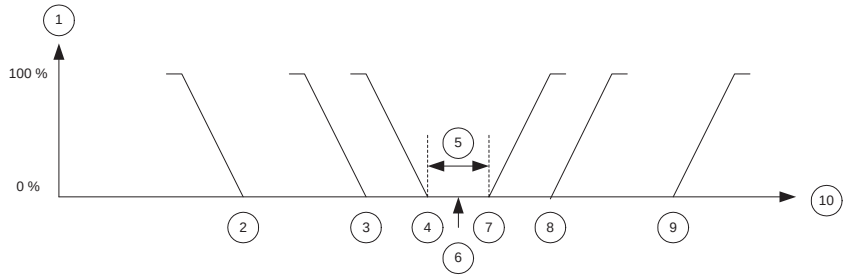
Normal operations

Heating and cooling logic

Description

ZN525 automatically determines whether heating or cooling is needed based on space and system conditions to maintain comfort levels. The controller measures the space temperature and reads the temperature setpoint to determine the required unit's heating or cooling capacity (0-100%) and to drive the fan speed (if in 'auto' mode) and the valve position accordingly. Smooth transition from Cooling to Heating / Heating to Cooling is ensured to avoid 'flickering' modes

Figure 2 - Normal operating mode



1. Control output
2. Unoccupied heating setpoint
3. Occupied standby heating setpoint
4. Occupied heating setpoint
5. Dead band
6. Local setpoint
7. Occupied cooling setpoint
8. Occupied standby cooling setpoint
9. Unoccupied cooling setpoint
10. Temperature

Benefits for end user

- The right mode to maintain ideal comfort conditions.
- Intelligent control algorithm which maintains the lowest possible sound level.

Benefits for operation manager

- Optimized for energy savings.
- Smooth transition from heating to cooling / cooling to heating, for ease of hot/cold water production control.

Normal operations

Electric heat operation

Description

The ZN525 controller supports 1-stage electric heat. Relay and triac outputs are available to control the electric heat (configurable).

To maintain the space temperature, electric heat is cycled to control the discharge air temperature. The electric heat output, like the heat modulating valve (0 to 100 %), is driven by the cascade control algorithm. A specific pulse width modulation (PWM) control algorithm converts capacity percentage to pulse width modulation.

The electric heater can be driven directly by embedded relay or by a triac output plus a static relay. In case of direct control by embedded relay, the minimum cycle time is 360 seconds. In case of control by triac, the minimum cycle time is 10 seconds.

Two pipe changeover units with electric heat will use the electric heater in addition to the hydronic heating when the heating valve actuator is fully open, but heating is not sufficient to deliver capacity to building thermal load.

Electric heat stops on demand limiting request. The nviAuxHeatEnable allows the building management system to enable or disable electric heat operation.

Benefits for end user

- Ensures ideal comfort conditions for occupants.

Normal operations

Modulating/Cascade control

Description

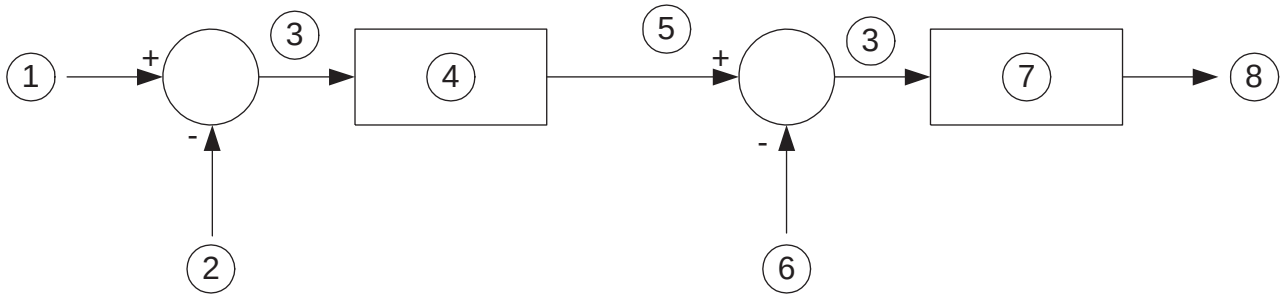
Modulating control

ZN525 provides comfort through hydronic valve and fan speed modulation proportional-integral control algorithm. Two modes can be used with ZN525:

Cascade control

When configured for cascade control, the unit controls the discharge air temperature to regulate the zone temperature.

Figure 3 - Cascade control block diagram



1. Active setpoint
2. Measured space temperature
3. Delta
4. Space temperature control
5. Calculated discharge air temperature setpoint
6. Measured discharge air temperature
7. Discharge air temperature control
8. Heat/cool capacity

Benefits for end user

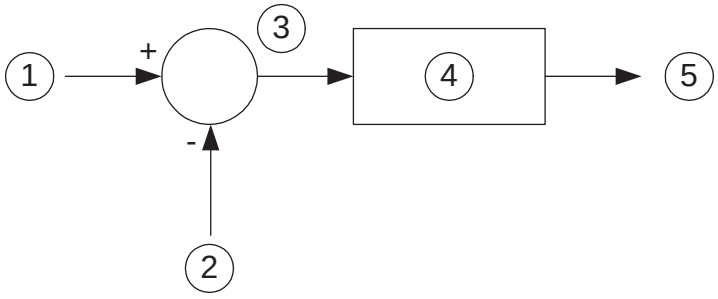
- Occupants do not feel cold/warm airflow thanks to the discharge air temperature limitation control.

Normal operations

Zone temperature Control

The zone temperature control algorithm compares the active setpoint (depending on the heat/cool mode) to the measured space temperature to produce a control error. The controller uses the control error in a proportional/integral control algorithm to calculate a unit heat/cool capacity accordingly. The end devices (valves and electric heat) operate based on the unit heat/cool capacity (heat or cool mode, 0 to 100%).

Figure 4 - Zone temperature control block diagram



1. Active setpoint
2. Measured space temperature
3. Delta
4. Space temperature control
5. Heat/cool capacity

Benefits for end user

- Control over the lowest possible fan speed maintains the lowest possible acoustic level.

Benefits for operation manager

- Energy savings through accurate adaptation of the delivered capacity according to the building needs.

Normal operations

Fan operation

Description

The ZN525 unit controller supports variable speed fans (0..10V).

Continuous or cycling fan operations are supported.

The controller, when in occupied mode, can control the fan speed automatically, if 'auto' is enabled either from the local zone sensor or the BMS.

If the 'off' mode is selected, the controller shuts down the fan, closes valves and waits for the command to return to either fan speed or 'auto'.

Fan speed override that takes place at the zone sensor level can be automatically reset from the BMS. If, for example, an occupant forces the fan to low speed during a meeting, the fan speed can be reverted to the 'auto'position through a command sent by the BMS, which will cancel the local zone sensor fan speed override.

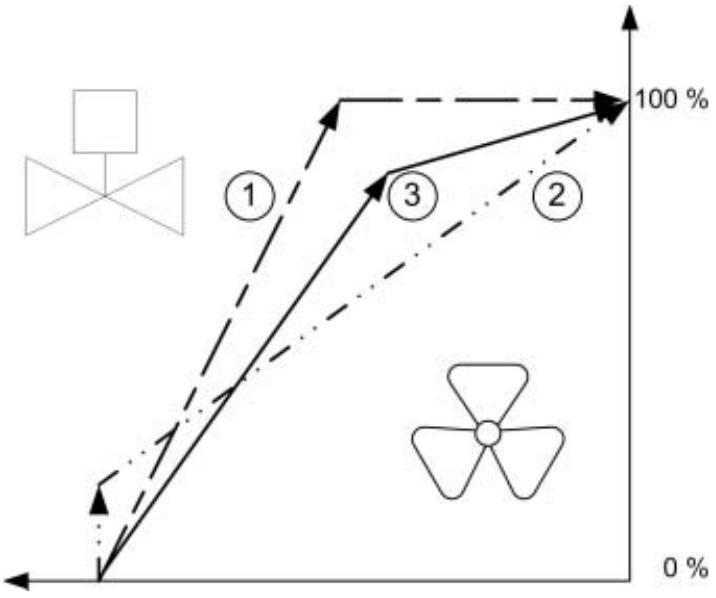
The variable speed fan operates:

- As a modulating actuator from 0% to 100% when the fan speed command is in Auto mode
- As a 1, 2 or 3-speed fan when the fan speed command is in Off, Low, Medium or High position.

Fan control

When in 'Auto' mode, the ZN525 intelligent control algorithm gives greater importance to heat/cool actuators while maintaining the lowest fan speed as possible.

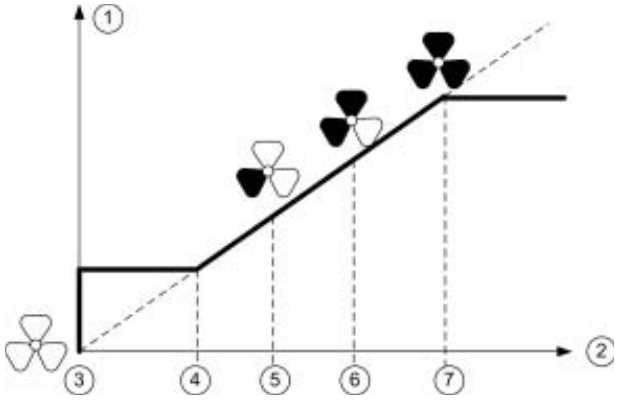
Figure 5a - Fan control



1. Actuator position
2. Fan speed
3. Unit capacity

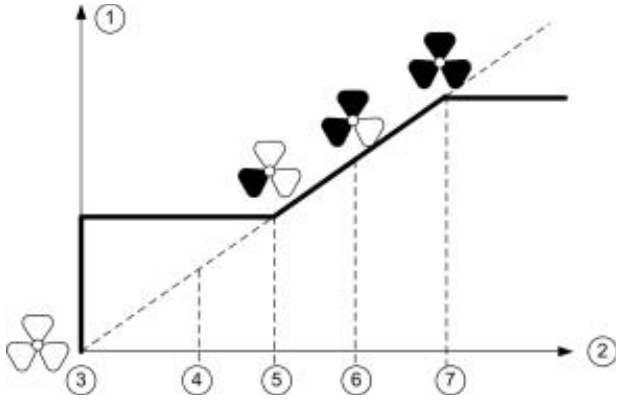
Normal operations

Figure 5b - Air flow in Cooling Mode



1 – Air flow
2 – Fan speed command
3 – Fan Off
4 – Minimum fan speed (adjustable parameter)
5 – Low fan speed (adjustable parameter)
6 – Medium fan speed (adjustable parameter)
7 – High fan speed (adjustable parameter)

Figure 5c - Air flow in Heating Mode



1 – Air flow
2 – Fan speed command
3 – Fan Off
4 – Minimum fan speed (adjustable parameter)
5 – Low fan speed (adjustable parameter)
6 – Medium fan speed (adjustable parameter)
7 – High fan speed (adjustable parameter)

Benefits for end user

- Aeraulic noises are eliminated through intelligent fan speed control.
- Greater energy savings through low fan power consumption.

Continuous fan operation

The continuous fan operation is required for the discharge air temperature control.

During occupied and occupied standby modes, the fan is usually on. For multiple speed fan applications, the fan normally operates at the selected or default speed (off, high, medium, or low). When the fan is in auto mode, the fan operates at the calculated fan speed given by the intelligent control algorithm.

During unoccupied mode, the controller turns off the fan while the temperature is within deadband of the active setpoint. Should the temperature drift outside of the deadband, the controller starts the fan to high speed and heats / cools the zone to adjust the temperature back within the heating / cooling deadband setpoint.

The unit fan is always off during occupied, occupied standby, and unoccupied modes when the unit is off due to a diagnostic or when the unit is in off mode due to the local zone sensor module, a communicated request, or the default fan speed (off).

If both a zone sensor module and a communicated request exist, the communicated request has priority.

Normal operations

Cycling fan operation

The cycling fan operation does not support the discharge air temperature control (cascade control algorithm). Selecting cycling fan operation implies using the zone temperature control only (single PI control algorithm) and not using discharge air temperature control.

The fan cycles between 'off' and the default fan speed during unoccupied, occupied, occupied standby, and occupied bypass operation.

The unit fan is always off during occupied, occupied standby, and unoccupied modes when the unit is off due to a diagnostic or when the unit is in off mode due to the local zone sensor module, a communicated request, or the default fan speed (off).

If both a zone sensor module and a communicated request exist, the communicated request has priority.

Benefits for end user

- Cascade Control: occupants do not feel cold/warm airflow thanks to discharge air temperature limitation control.
- Minimum fan speed maintains the lowest possible acoustic level.

Fan off delay

When any heating source is turned from 'on' to 'off' state, the ZN525 controller holds the fan on for additional seconds (adjustable from 0 to 600 sec, default value 30 sec).

Benefits for operation manager

- Safety through the extra time given to the fan to blow off any residual heat from the heating source.

Fan speed rampup

On a fan speed change (user's override) or on a mode change (ex: unoccupied to occupied), ZN525 limits the acceleration of the fan for a couple of seconds.

Benefits for the end user

- Aerolic noises through fan speed change are eliminated.

Normal operations

Trane communicating zone sensor module (ZSM)

Description

Trane communicating zone sensor module is a human interface for building users where water terminal units are used. Innovative in its design and function set, this interface offers user friendly comfort control, as well as occupant unique features.

Space temperature measurement

The zone sensors can display either the local space temperature or the return air temperature given by the controller sensor. The zone sensor indicates the space temperature on changes of 0.1°C and every 10 minutes.

Temperature setpoint adjustment

The ZN525 zone sensor provides two temperature setpoint adjustment methods:

Absolute setpoint

The zone sensor allows the occupant to adjust the space temperature setpoint within a specified range.

Relative setpoint

The zone sensor allows the occupant to increase or decrease the space temperature setpoint.

Zone sensors synchronization

In an installation with several zone sensors, ZN525 can share the same variables (active operator temperature setpoint, fan speed request, timed override on and cancel requests) with every zone sensors. Occupants can adjust the room temperature setpoint from any zone sensors in the room, the 'modified' setpoint is then sent to all zone sensors.

Fan speed adjustment

The zone sensor fan switch provides the controller with an occupied (and occupied standby) fan request signal (Off, Low, Med, High, Auto). If the fan control request is communicated to the controller, the controller ignores the zone sensor fan switch input and uses the communicated value.

The zone sensor fan switch input can be enabled or disabled through configuration, using the service tool plug-in. If the zone sensor switch is disabled, the controller will resort to its stored configuration default fan speeds for heating and cooling, unless the controller receives a communicated fan input.

When the fan switch is placed in the 'off' position, the controller does not control any unit capacity. The unit remains powered, and all the outputs are driven to a closed position.

Normal operations

Occupancy button and status

Momentarily pressing the occupancy button during unoccupied mode places the controller in occupied bypass mode for 120 minutes (Number of minutes adjustable by using the service tool). The controller remains in occupied bypass mode until the override time expires or until the occupancy button is pressed for at least 5 seconds.

The zone sensor displays the controller occupancy status (occupied, occupied bypass, occupied stand-by and unoccupied).

Window contact display

When the zone sensor receives the status of the window contact switch wired to the ZN525 controller, an open window icon displays on the zone sensor screen. The user can read why the unit is off.

Occupant call

Following a pre-defined key sequence, the occupant can generate a call to the building management system. The occupant call is similar to the nurse call in hospitals. Once the pre-defined key sequence has been entered, the zone sensor sends the occupant call request to the ZN525 controller. The ZN525 controller sets the dedicated network variable output to ON and generates an *Occupant call* diagnostic. Re-pressing the pre-defined key sequence resets the occupant call.

Table 7 - Trane zone sensor for ZN525 characteristics

Main features	Description
Push buttons	Large push buttons: Setpoint adjustment (increase / decrease), fan speed (auto/off/low speed/medium speed / high speed, timed override, + various combinations.
LCD display	Logos: fan, occupancy, temperature, window open, fault
Indications	Absolute temperature, current absolute or relative setpoint, occupancy status, controller fault status, active occupant call status, window open status, maintenance call
Zone sensor	Included in the wall interface Measures temperature between +5°C and 30 °C, accuracy of 0.2 °C Sensor is automatically disabled when remote controller uses 'return air'
Connexion to controller	RJ 9 connector

Normal operations

Benefits for contractor

- Ease of installation: the wall sensor is powered by the controller to which it is attached.

Benefits for owner

- The floor layout can be modified when no new wiring requirements are included.

Benefits for end user

- Ease of use: it offers an intuitive interface to occupants.

Benefits for operation manager

- Ease of maintenance: simple diagnostic interface for building maintenance people.

Normal operations

Communication

Description

For optimal system performance, fan coil units can operate as part of a BMS. ZN525 unit controllers are linked directly via a twisted unshielded pair cable to the Tracer Summit™ building control unit which acts as a communication server.

Peer-to-peer communication

The ZN525 unit uses LON communication interface type FTT - 10A. It allows peer-to-peer (also referred to as master/slave) data communication. To simplify setting up "master/slave" applications, the controller provides information that groups all necessary shared data into one communication variable. This master/slave variable includes the following information which is communicated from the master to the slave to ensure similar unit operation:

- Effective setpoint.
- Heating/cooling mode.
- Occupancy.
- Fan speed.
- Space temperature.

Partial master/slave mode

Master imposes to slave:

- Effective setpoint.
- Heating/cooling mode.
- Occupancy.
- Fan speed command value.

Each slave controls its valves to adjust the local heat/cool load. It will either control its fan speed automatically, providing the fan speed command at the master level is in Auto mode, or will force it to the value requested by the master.

Benefits end user

- Comfort through local adjustment of the heat/cool load.

Benefits for operation manager

- Savings through same setpoint and occupancy mode sharing.

Normal operations

Full master/slave mode

Master imposes to slave:
- Effective setpoint.
- Heating/cooling mode.
- Occupancy.
- Fan speed command value.
- Valves/Electric heat position.

Benefits end user
- Homogeneous acoustic level in the open spaces.

Interoperability

ZN525 conforms to the LonMark® Space Comfort Controller (SCC) profile and communicates via the LonTalk® protocol.

Benefits for contractor
- Reduced wiring through the use of software links.
- Full compatibility with other Lon controllers (from Trane or other suppliers).

Benefits for owner
- Can be integrated into any control systems that support LonTalk® and the SCC profile.
- Flexibility for building changes: master/slave interactions can be modified when changes made to the floor layout include few specific engineering requirements.
- Compatible with Trane user interfaces (Communicating zone sensor, Trane's BMS: touch screen on a BCU or Tracer Summit™ software, standard web browser).

Benefits for operation manager
- Multiple units serving a large space operate more efficiently when sharing properties such as heating/cooling mode and setpoints, avoiding energy waste and occupant complaints.

For futher details, refer to the official documentation LonWorks® FTT-10A free topology transceiver user's guide and to the official LonWorks® guidelines LonMark® layer 1-6 interoperability guidelines version 3.3.

Advanced operations

Space low temperature

Description

Space low temperature is used as low ambient temperature protection and can be invoked anytime.

The controller enters the space low temperature mode when the space temperature is below the space low temperature avoidance setpoint (configurable). The controller disables the space low temperature when the space temperature rises 2°C above the space low temperature setpoint.

When the controller has generated a space low temperature diagnostic:
- All water valves are driven open to allow water to flow through the coil.
- Fan will be off.
- Electric heat (when present) will be off.

Benefits for operation manager
- Safety: the controller sends an alarm to immediately notify the maintenance team.

Freeze protection

Description

Freeze protection operation is invoked whenever the discharge air temperature falls below the discharge air temperature low limit. During freeze protection operation, the controller increases the heating capacity or decreases the cooling capacity in order to raise the discharge air temperature above the limit.

If the discharge air temperature remains below the limit for eight minutes, the controller generates a *Discharge air temp low limit* diagnostic.

When the controller has generated a *Discharge air temp low limit* diagnostic:
- All water valves are driven open to allow water to flow through the coil.
- Fan will be off.
- Electric heat (when present) will be off.

Benefits for operation manager
- Safety: the controller drives all of the valves open to help prevent the coil from freezing.

Condensate overflow input

Description

The condensate overflow switch is physically connected to a discharge air temperature sensor input. A condensate overflow signal generates a diagnostic which overrides the fan at low speed, closes all unit water valves (when present) and turns off any electric heat (when present) although the actual condensate overflow switch automatically resets when the condensation returns to a normal level.

Benefits for operation manager
- Safety: The controller shuts down the unit and sends out an alarm.

Advanced operations

Window contact management

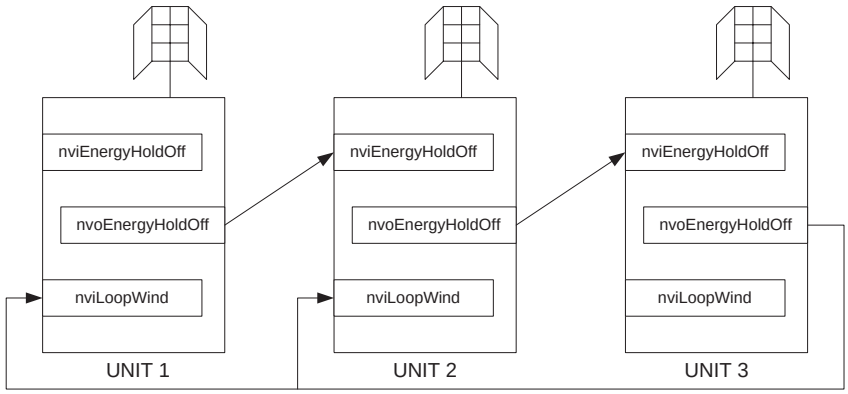
Description

In case of an open window, the unit closes valves, fan and electric heater. In a room with several units, it is recommended to stop all units if at least one of the room window is open. The function implemented in ZN525 performs the following actions:

- Stops the unit where the window is open.
- Generates a *Window contact* diagnostic (diagnostic is cleared when condition is OFF).
- Informs other units in the same room that a window is open.

This function is associated with the following binding scheme:

Figure 6 - Window contact management



Energy Hold Off Input - nviEnergyHoldOff:
This input is used to stop heating and cooling while allowing the unit to protect the space from extreme temperature. This input is usually associated with a device such as a window contact sensor. If a physical sensor is connected and the network variable is present, either input can initiate Energy Hold Off. (Energy Hold Off = HVAC-OFF)

Window Contact Loop Input - nviLoopWind:
This input is used to loop the window contact when several units share the same room.

Benefits for operation manager

- Energy savings are optimized by disabling the cooling / heating sources and the units fans when the room window is opened.

Special functions

Entering water temperature sampling

Description

In a 2-way valve application, the valves close when the water temperature cannot deliver the needed capacity. The controller will periodically check the water temperature by opening up the valve for a couple of minutes, allowing water flow to regulate and accurate water temperature measure to be done. If the measured water temperature is higher than the actual space temperature, the controller assumes it is capable of delivering the needed heating capacity to the space. If the water temperature is lower than the actual space temperature, cooling capacity is expected. If cooling is required and the cooling capacity availability has been confirmed, the controller resumes normal operation. The same sequence occurs for heating demands. If the coil capacity is opposite the need, the controller closes the valves for 60 minutes after which a capacity determination process is repeated.

Benefits for end user

- Prevents inaccurate readings of entering water temperature which could lead to comfort problems.
- Allows standalone units to work properly on 2-pipe change over / 2-way valves applications.

Benefits for operation manager

- Provides smooth and reliable heating and cooling control.

Special functions

Filter maintenance status / Run hours

Description

The controller filter status is based on the unit fan's cumulative run hours. The controller compares the fan run time against an adjustable fan run hours limit. Once the setpoint limit is exceeded, the controller generates a *Maintenance Required* diagnostic.

You can use the service tool to:

- Modify the maintenance required setpoint time.
- Clear the maintenance required setpoint time: the controller disables the diagnostic feature, resets the fan runtime to zero and begins accumulating fan runtime hours again.

Benefits for operation manager

- Ease of preventative maintenance: the controller automatically notifies operators when the unit has run over a preset amount of time.

Electric heater run hours

Description

The controller supports an electric heater's cumulative run hours counter that can be reset at a specified value.

Electric heater run hours are stored in EEPROM twice a day.

Benefits for operation manager

- This function allows to perform power metering.
- It allows for easy building optimization.

Special functions

Demand limiting

Description

The building management system sends a demand limiting request to the controller. In this case the ZN525 disables its electric heater.

Benefits for operation manager

- Energy savings: Turning off the electric heater reduces a facility's peak electrical-demand charge for air-conditioning by transferring loads to off-peak hours. Demand limiting reduces the amount of electricity used during utility peak hours, thus reducing electrical-demand charges and electrical utility bills.

Output overrides

Description

The controller includes the capability to override outputs (typically for test and commissioning) from Trane service tool software.

Field output test (nviTraneVar1401)

The controller offers a field output test function which allows the user to manually test the outputs in a predefined sequence. A field output test can be terminated by running though the entire test sequence. The controller will time out and reset if the unit remains at the same step for one hour. Contact types (NO/NC) are not used in this test.

Table 8 - ZN525 controller output states

	Electric Heat Relay	Heat valve close	Heat valve open	Cool valve close	Cool valve open	Fan Relay	Fan Control
	BO6	**BO5**	**BO4**	**BO3**	**BO2**	**BO1**	**AO1**
1 - Off[1]	Off	On	Off	On	Off	Off	**0 V**
2 - Fan high	Off	Off	Off	Off	Off	**On**	**10 V**
3 - Fan medium[2]	Off	Off	Off	Off	Off	**On**	**6.6 V**
4 - Fan low[3]	Off	Off	Off	Off	Off	**On**	**3.3 V**
5 - Cool triac open	Off	Off	Off	Off	**On**	**On**	**High**
6 - Cool triac close	Off	Off	Off	**On**	Off	**On**	**High**
7 - Heat triac open	Off	Off	**On**	Off	Off	**On**	**High**
8 - Heat triac close	Off	**On**	Off	Off	Off	**On**	**High**
9 - Heat relay	**On**	Off	Off	Off	Off	**On**	**High**
10 - Exit[4]							

Note 1: Upon entering field output test mode, the controller turns off all fan and electric heat outputs and drives all valves closed.
Note 2: If the unit is configured for a 2-speed fan, the fan remains on high speed at step 3.
Note 3: If the unit is configured for a 2-speed fan, the low fan speed output energizes at step 4. If the unit is configured for a 1-speed fan, the fan remains on high speed at step 4.
Note 4: After step 9, the test sequence performs an exit. This initiates a reset and attempts to return the controller to normal operation.

Benefits for contractor

- Ease of installation for test and commissioning.

Special functions

Water valves override at power-up

Description

The controller includes the function to override water valves at power up. This feature allows easy water balancing of the system. At the first power-up, the controller fully opens water valves for a factory-configured period of time (typically 4 hours). Water valves remain open until this period of time has elapsed. After 4 hours have elapsed, the controller resets and starts normal operation.

Benefits for contractor

- Ease of installation: typically for test and commissioning, by using Trane Tracer Summit™ building automation system or Rover service tool. This function drastically reduces the time required to balance the water distribution system.

Diagnostics

Diagnostics can be of different types:

Non-latching diagnostics perform a controller Fallback mode and automatically restart when the input is present and valid. The diagnostic is cleared when the input is present and valid.

Latching diagnostics perform a controller Fallback mode and automatically restart when the input is present and valid. The diagnostic is maintained until a controller reset occurs.

Informational diagnostics automatically disappear when the condition no longer exists.

Diagnostics

Table 9 - ZN525 controller diagnostics

Diagnostic	Diag. #	Fan	Cool Valve	Heat Valve	Electric Heat	Diag. Type (notes 3,5)
Space Temperature Failure	1	Off	Open	Open	Off	Non-latching
Discharge Air Temp Failure (note 4)	2	Off	Open	Open	Off	Non-latching
Low Space Temperature	3	Off	Open	Open	Off	Latching
Discharge Air Temp Low Limit	4	Off	Open	Open	Off	Latching
Condensate Overflow	5	Low Speed	Closed	Closed	Off	Non-latching
Window Contact	6	Off	Closed	Closed	Off	Informational
Entering Water Temp Failure (note 1)	7	Enabled	Closed	Enabled	Enabled	Non-latching
Zone Sensor Failure (note 6)	8	Enabled	Enabled	Enabled	Enabled	Non-latching
Maintenance Required Time	9	Enabled	Enabled	Enabled	Enabled	Informational
Occupant Call	10	Enabled	Enabled	Enabled	Enabled	Informational
Maintenance Request	11	Enabled	Enabled	Enabled	Enabled	Informational
Manual Output Test (note 2)	12	Off	Closed	Closed	Off	Informational
Valve Override Mode	13	Off	Open	Open	Off	Informational
Application Resetting	14	Off	Off	Off	Off	Informational
Normal	15	Enabled	Enabled	Enabled	Enabled	Informational

Note 1: When the entering water temperature is required but not present, the ZN525 controller generates a diagnostic to indicate the sensor loss condition. The controller automatically clears the diagnostic once a valid entering water temperature value is present (non-latching diagnostic). When the entering water temperature sensor fails, the controller prohibits all cooling operation but allows the delivery of heat when heating is required. In the Cool mode, all cooling is locked-out, but normal fan operation is permitted.

Note 2: During manual output test mode, normal operation is frozen, all outputs are in their off state. The manual output test mode energizes output following a pre-defined sequence. The test sequence must be completed to allow the controller to switch to normal operation.

Note 3: Non-latching diagnostics perform a controller fallback mode and automatically restart when the input is present and valid. The diagnostic is cleared when the input is present and valid.
Latching diagnostics perform a controller fallback mode and automatically restart when the input is present and valid. The diagnostic is maintained until a controller reset occurs.
Informational diagnostics automatically disappear when the condition no longer exists.

Note 4: Discharge air temp failure diagnostic can occur when the discharge air temperature sensor has failed (open or short circuit) or when the condensate overflow input is shorted (creates a short circuit on the discharge air temperature sensor).

Note 5: nvoUnitStatus.In_Alarm and the 'unit failure' sign of the zone sensor are set when a latching or a non-latching diagnostic is present.

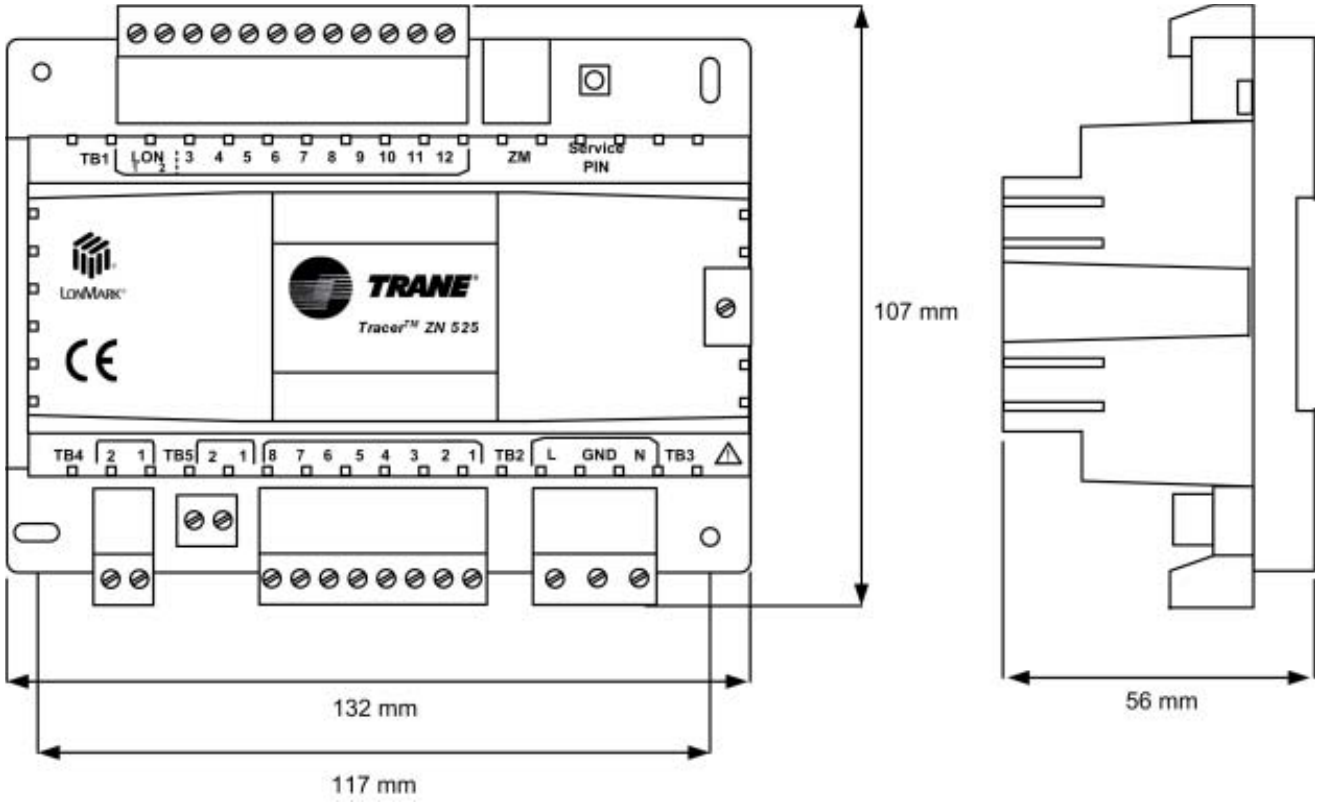
Note 6: This diagnostic occurs when the zone sensor space temperature has not been updated for 15 minutes.

Characteristics and specifications

Dimensions

ZN525 dimensions are shown in the following figure.

Figure 7 - ZN525 Dimensions



Characteristics and specifications

Specifications

Table 10 - ZN525 unit controller specifications

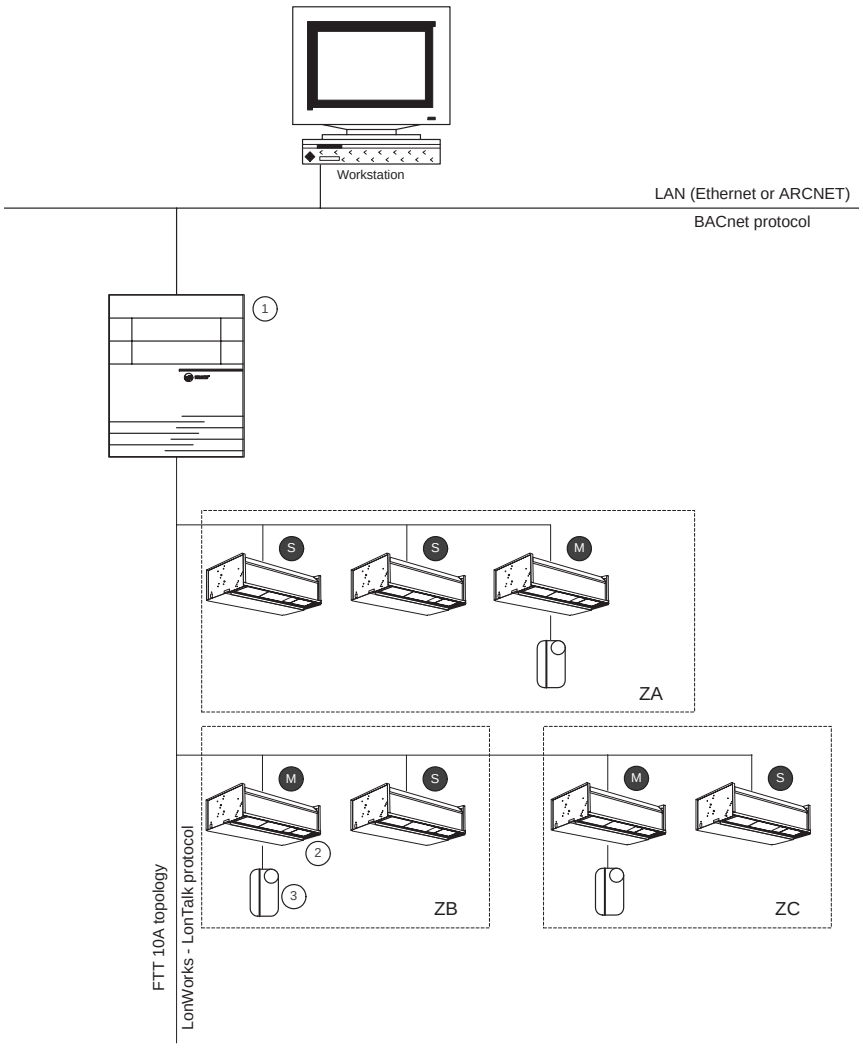
Board dimensions	107 mm height x 132 mm width x 56 mm depth
Operating environment	Temperature: from 0° to 60°C Relative Humidity: from 5% to 95% non-condensing Dust protection: pollution level 1
Storage environment	Temperature: from -40°C to 85°C Relative Humidity: from 5% to 95% non-condensing
Power requirements	230 Vac (+10%/-15%) 50 or 60 Hz 3 A maximum (all outputs utilized)
Standards	89/336/EEC European directive for electromagnetic compatibility: • Immunity: 61000-6-1 • Emission: 61000-6-3 73/23/EEC European directive for low voltage electrical equipment: • EN 60335-1 • EN 60335-2-40
Protection class	IP 20
Diagnosis interface	3 LEDs 1 Service Pin push button
Communication	LonTalk® protocol SCC 8501 profile Network type FTT 10A

Characteristics and specifications

Network architecture

The Tracer™ zone controllers shown in the figure below can operate on a Tracer Summit™ building automation system, on a LonTalk® peer-to-peer network or as stand-alone devices.

Figure 8 - ZN525 network architecture

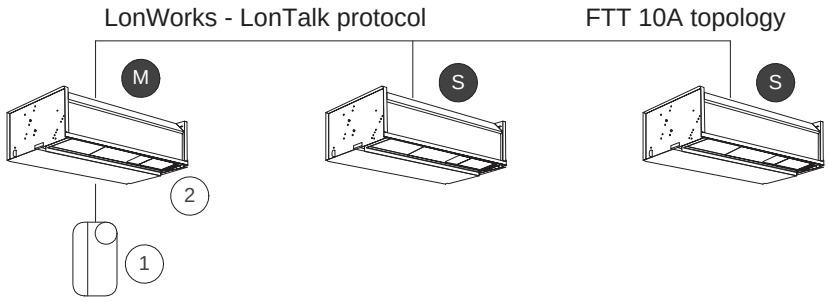


1. Tracer Summit™ Building Control Unit.
2. Terminal unit + ZN525.
3 Trane communicating zone sensor module.

M.ZN525 controller with zone sensor
S. ZN525 controller without zone sensor
Z. Zone.

Characteristics and specifications

Figure 9 - ZN525 peer-to-peer architecture



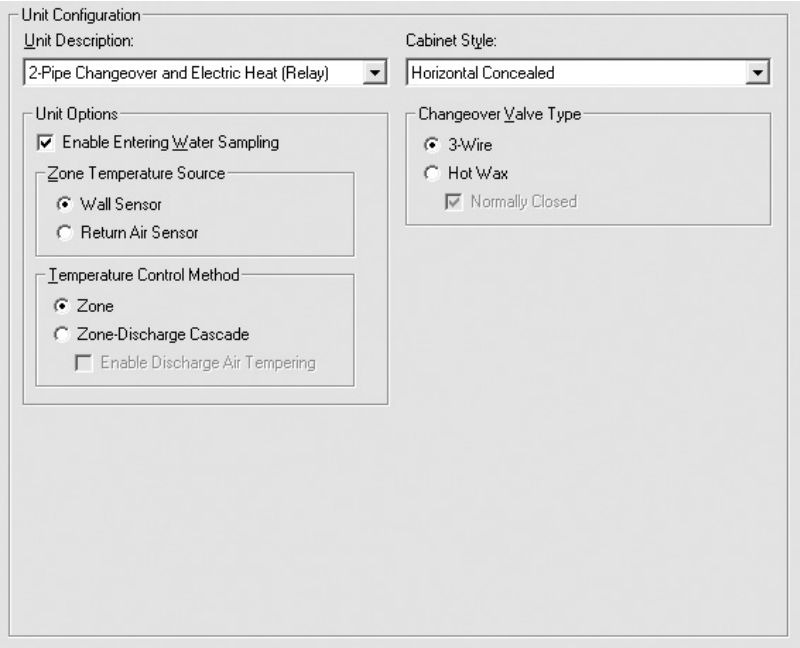
1. Terminal unit + ZN525.
2 Trane communicating zone sensor module.
M.ZN525 controller with zone sensor
S. ZN525 controller without zone sensor

Characteristics and specifications

Setup

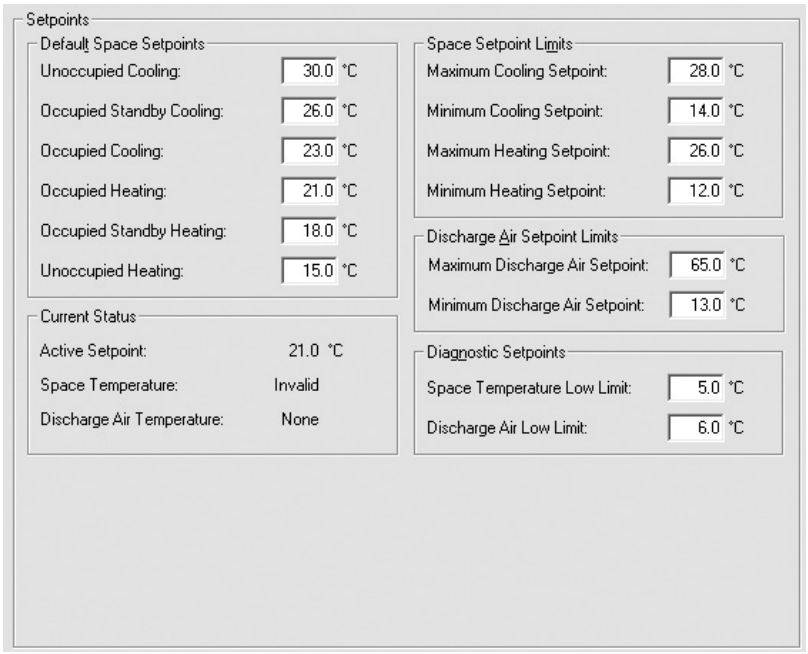
The Trane service tool allows to monitor, configure and test ZN525 via a connection to the communication link or directly to the controller (when stand-alone).

Figure 10 - Trane service tool - Unit configuration



Characteristics and specifications

Figure 11 - Trane service tool - Unit setpoints configuration



Characteristics and specifications

ZN525 network variables list

Table 11 - ZN525 Network variable list

NV Name	NV type	Description
nciDevMajVer	SCPTdevMajVer	Device Major Version
nciDevMinVer	SCPTdevMinVer	Device Minor Version
nciBypassTime	SCPTBypassTime	Local Bypass Time
nciMinOutTm	SCPTminSendTime	Minimum Send Time
nciRcvHrtBt	SCPTmaxRcvTime	Receive Heartbeat
nciSndHrtBt	SCPTmaxSendTime	Send Heartbeat
nciLocation	SCPTlocation	Location Label
nciSetpoints	SCPTlocation	Occupancy Setpoints
nciVarSpeedConf	UCPT var Speed Conf	Fan Variable Speed Configuration
nviRequest	SNVT_obj_request	Status request
nviSpaceTemp	SNVT_temp_p	Space Temperature Input
nviSetpoint	SNVT_temp_p	Temperature Setpoint Input (absolute)
nviOccSchedule	SNVT_tod_event	Occupancy Scheduler Input
nviOccManCmd	SNVT_occupancy	Occupancy Override Input
nviOccSensor	SNVT_occupancy	Occupancy Sensor Input
nviApplicMode	SNVT_hvac_mode	Application Mode Input
nviHeatCool	SNVT_hvac_mode	Heat/Cool Mode Input
nviFanSpeedCmd	SNVT_switch	Fan Speed Command Input
nviAuxHeatEnable	SNVT_switch	Auxiliary Heat Enable Input
nviValveOverride	SNVT_hvac_overid	Water valve override control
nviSourceTemp	SNVT_temp_p	Source Temperature Input
nviEnergyHoldOff	SNVT_switch	Energy Hold Off Input
nviMstrSlv4	UNVT_MstrSlv4	Master slave control
nviLoopWind	SNVT_switch	Window contact loop input
nvoStatus	SNVT_obj_status	Status request
nvoFileDirectory	SNVT_address	Memory address of file (data table)
nvoAlarmMessage	SNVT_str_asc	Diagnostic Message structure
nvoSpaceTemp	SNVT_temp_p	Effective Space Temperature Output
nvoUnitStatus	SNVT_hvac_status	Unit Status Output
nvoEffectSetpt	SNVT_temp_p	Effective Setpoint Output
nvoEffectOccup	SNVT_occupancy	Effective Occupancy Output
nvoHeatCool	SNVT_hvac_mode	Effective Heat/Cool Output
nvoSetpoint	SNVT_temp_p	Local Setpoint Output
nvoFanSpeed	SNVT_switch	Effective Fan Speed
nvoDischAirTemp	SNVT_temp_p	Discharge Air Temperature Output
nvoTerminalLoad	SNVT_lev_percent	Terminal Load Output
nvoEnergyHoldOff	SNVT_switch	Energy Hold Off Output
nvoEnterWaterTmp	SNVT_temp_p	Entering Water Temp
nvoMstSlvStat	UNVT_mstslv	Master slave status

Mounting and wiring

Description

Direct 230 Vac power supply.

Clearly labelled screw terminals.

Compact enclosure design.

Easy Lon network connection.

Simple phone type cable with RJ9 quick connection for cabling between ZN525 and the zone sensor.

Supports any type of water terminal unit configuration.

Benefits for contractor

- Commissioning time/cost reduced
- No additional power supply transformer
- Quick cabling of zone sensor
- Removable screw terminals for ease of maintenance
- Screw terminals for high quality connections
- Reduced foot print on units
- No additional relay for electric heaters of power <1.8 kW
- Only one controller whatever the water terminal application type.

Benefits for owner

- High flexibility for building changes.

Configurations

Description

The controller is applied to fan coil configurations supporting 3-wire modulating valves, thermal (hotwax) modulating valves and 1 stage electric heater. It also supports variable fan speeds.

Table 12 - Typical applications supported

Configurations	Type of valve		Type of electric heat	
	3-wire modulating	Thermal modulating	Relay	Triac for external solid state relay driving
2-pipe cooling only				
2-pipe heating only	X	X		
2-pipe changeover	X	X		
2-pipe cooling only + electric heat	X	X	X	X
2-pipe changeover + electric heat	X	X	X	X
4-pipe	X	X		

Benefits for contractor

- Simplified installation: the same controller is used for all of the applications.

Troubleshooting

Led operation

Red Service LED

Table 13 - Red Service LED activity

Red LED Activity	Description
LED is Off continuously after power is applied to the controller.	Normal operation.
LED is On continuously, even when power is first applied to the controller.	Someone actuated the Service push button or the controller has failed.
LED blinks (1/4 second on, 1/4 second off for 10 seconds).	Wink mode : • Identify a device • Verify that the controller is communicating on the link
LED flashes about once every second.	Uninstall (normal controller mode). Use service tool to restore the unit to normal operation.

Service push button

The Service push button located at the top right corner of the controller can be used (one of several methods) to install the ZN525 unit controller in a communication network.

Green Status LED

The green LED is normally used to indicate whether or not the controller is powered on.

Troubleshooting

Diagnostics

Diagnostics can be of different types:

Latching diagnostics perform a controller Fallback mode and automatically restart when the input is present and valid. The diagnostic is maintained until a controller reset occurs.

Non-latching diagnostics perform a controller Fallback mode and automatically restart when the input is present and valid. The diagnostic is cleared when the input is present and valid.

Informational diagnostics automatically disappear when the condition no longer exists.

There are many ways to reset unit diagnostics:

- **Automatically by the controller:** The ZN525 unit controller includes an automatic diagnostic reset function. This function attempts to automatically recover a unit when a non-latching diagnostic occurs. The automatic diagnostic reset function clears the non-latching diagnostic and attempts to restore the controller to normal operation. The controller resumes normal operation until another diagnostic occurs.
- **By cycling power to the controller:** When someone turns off the controller's power, then re-applies power, the unit cycles through a power up sequence. By default, the controller will attempt to reset all diagnostics at power up. Diagnostics present at power up and those that occur after power up will be handled according to the defined unit diagnostics sequences.
- **By using any communicating device able to access the controller's diagnostic reset input:** Any device that can communicate network variable nviRequest (enumeration "clear_alarm") can reset diagnostics in the ZN525 unit controller.
- **By sending a controller reset command from the zone sensor:** If the user initiates (via a pre-defined key sequence) a reset command from the zone sensor, the controller resets all diagnostics. Diagnostics may recur immediately if the problem still exists.

Troubleshooting

The **LATCHING** diagnostics are:

- **Freeze Protection**: is invoked whenever the discharge air temperature falls below the discharge air temperature low limit.
- If the discharge air temperature remains below the limit for eight minutes the controller generates a *Discharge air temp low limit diagnostic*, then:

Fan	Cool valve	Heat valve	Electric heat
Off	Open	Open	Off

- **Space low temperature**: is used as low ambient temperature protection and can be invoked anytime. The controller enters the space low temperature mode when the space temperature is below the space low temperature avoidance setpoint (configurable).
- When the controller has generated a *space low temperature diagnostic* then:

Fan	Cool valve	Heat valve	Electric heat
Off	Open	Open	Off

- The controller disables space low temperature when the space temperature rises 2°C above the space low temperature setpoint.

The **NON-LATCHING** diagnostics are:

- **Return air temperature / Local zone temperature**: The ZN525 unit controller receives the space temperature from either the zone sensor, a communicated value (from a building management system) or a wired local sensor (return air temperature). When none of those space temperature sources is present, the ZN525 unit generates a *Space Temperature Failure diagnostic*.
- When the controller has generated a *space temperature failure diagnostic* then:

Fan	Cool valve	Heat valve	Electric heat
Off	Closed	Closed	Off

Troubleshooting

- **Entering water temperature**: When the entering water temperature is required but not present, the ZN525 controller generates a diagnostic to signal a loss condition to the sensor. The controller automatically clears the diagnostic once a valid entering water temperature value is present (non-latching diagnostic). When the entering water temperature sensor fails, the controller prohibits all cooling operations, but allows the delivery of heat when heating is required. In Cool mode, all cooling is locked-out, but normal fan operation is permitted.
- When the controller has generated an *entering water temperature diagnostic* then:

Fan	Cool valve	Heat valve	Electric heat
Enabled	Closed	Enabled	Enabled

- **Discharge Air Temperature Failure**: The discharge air temperature is used as a control input to the controller for discharge air temperature tempering. Once a valid discharge air temperature signal has been established by a thermistor and the value is no longer present, the controller generates a *Discharge Temperature Failure diagnostic* and performs a unit shutdown, then:

Fan	Cool valve	Heat valve	Electric heat
Low speed	Closed	Closed	Off

- When the sensor returns to a valid input, the controller will automatically allow the unit to resume operation.
- Warning: A condensate overflow contact can be wired in parallel with the discharge air temperature sensor. When this contact is closed, the input is shorted and the controller considers there is a condensate overflow.

- **Zone sensor communication loss**: The zone sensor sends its space temperature at least every 10 minutes. If the controller does not receive an update for 15 minutes, the communication with the zone sensor is lost. The controller switches to the local space temperature, switches to default fan speed and generates a *Zone sensor failure* diagnostic.
- When the controller has generated a *zone sensor failure diagnostic* then:

Fan	Cool valve	Heat valve	Electric heat
Enabled	Enabled	Enabled	Enabled

- **Condensate overflow** A condensate overflow can be detected using the contact wired in parallel with the discharge air temperature sensor. When this contact is closed, the controller disables cooling and heating and maintains the fan running at low speed.
- When the controller has generated a *condensate overflow* diagnostic then:

Fan	Cool valve	Heat valve	Electric heat
Low speed	Closed	Closed	Off

Troubleshooting

The **INFORMATIONAL** diagnostics are:

- **Filter Maintenance status** / **Run hours**: For ease of maintenance the ZN525 unit controller has a built-in timer that can initiate an alarm notification when it reaches zero. The controller's filter status is based on the unit fan's cumulative run hours. The controller compares the fan run time against an adjustable fan run hours limit (default value is 600 hours) and recommends unit maintenance as required. Once the setpoint limit is exceeded, the controller generates a *maintenance required diagnostic*.
- When the controller has generated *a maintenance required time diagnostic* then:

Fan	Cool valve	Heat valve	Electric heat
Enabled	Enabled	Enabled	Enabled

- You can use the service tool to clear *maintenance required diagnostic*. Once the diagnostic is cleared, the controller resets the fan runtime to zero and begins accumulating fan run hours again.

- **Window contact input**: the window contact switch is physically connected to a binary input of the controller (BI2). When a window is opened, the binary input detects the diagnostic condition. The window contact can be configured as normally open (NO) or normally closed (NC).
- When the controller has generated a *window contact diagnostic* then:

Fan	Cool valve	Heat valve	Electric heat
Off	Closed	Closed	Off

- The actual window contact switch automatically resets when the window is closed and the diagnostic is automatically cleared.

- **Occupant call**: Following a pre-defined key sequence, the occupant can generate a call to the building management system. Once the pre-defined key sequence has been entered, the zone sensor sends the occupant call request to the ZN525 controller. ZN525 then generates an *Occupant call diagnostic*.
- When the controller has generated an *Occupant call diagnostic* then:

Fan	Cool valve	Heat valve	Electric heat
Enabled	Enabled	Enabled	Enabled

- Re-pressing the pre-defined key sequence resets the occupant call.

Troubleshooting

- **Maintenance request**: Following a pre-defined key sequence, maintenance personnel can generate a 'request' to the building management system and then identify the unit where the maintenance request has been initiated. Once the pre-defined key sequence has been entered, the zone sensor sends the maintenance request to the ZN525 controller. The ZN525 controller generates a Maintenance request diagnostic.
- When the controller has generated a *maintenance request diagnostic* then:

Fan	Cool valve	Heat valve	Electric heat
Enabled	Enabled	Enabled	Enabled

- The maintenance ping resets (OFF) automatically after 60 minutes.

- **Output overrides**: The ZN525 unit controller includes a manual output test function. This function can be initiated via communications using the manual test variable. Use this feature to manually test the outputs in a defined sequence.
- When the controller has generated an *output overrides diagnostic* then:

Fan	Cool valve	Heat valve	Electric heat
Off	Closed	Closed	Off

- During manual output test mode, normal operation is frozen, all outputs are in their off-state. The manual output test mode energizes output following a pre-defined sequence.
- The test sequence must be completed to allow the controller to switch to normal operation.

- **Water valves override at power-up**: The controller includes a function to override water valves at power up. This function simultaneously opens all water valves in every unit.

Fan	Cool valve	Heat valve	Electric heat
Off	Open	Open	Off

This feature allows easy water balancing of the system. At the first power-up, the controller fully opens water valves for a factory-configured period of time (4 hours). Water valves will remain open until this period of time has elapsed.
After 4 hours, the controller resets and starts normal operation.

Notes

Notes

Notes

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