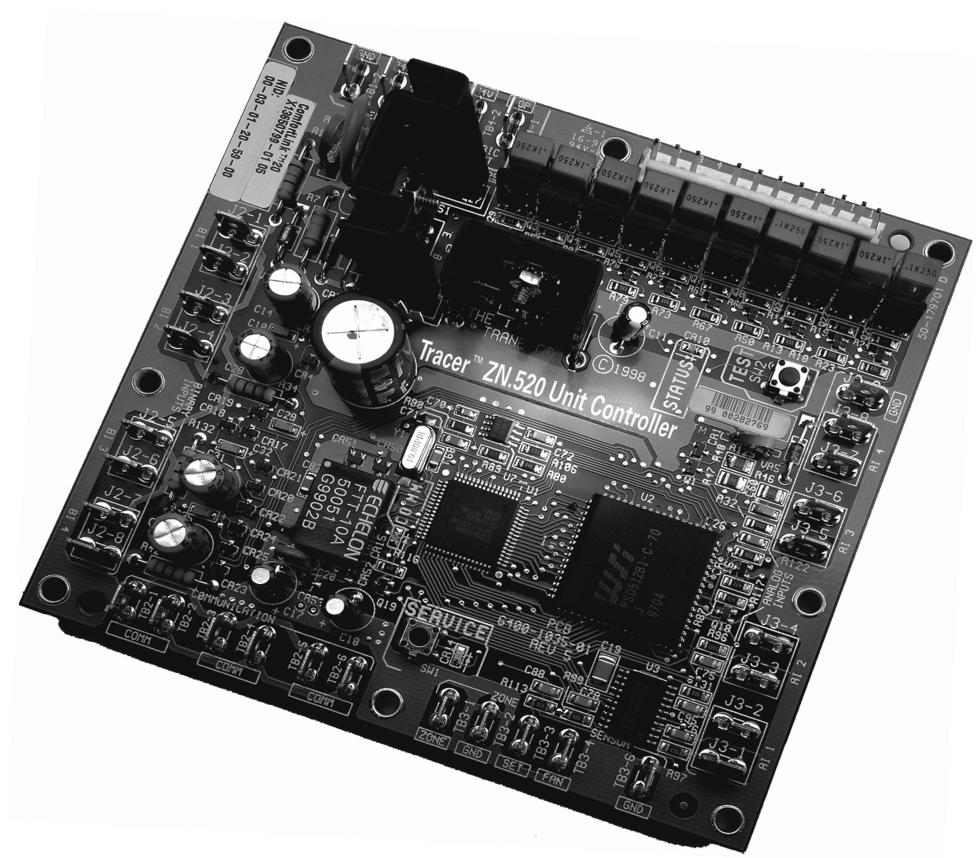
TRANE®

Installation, Operation, and Maintenance

Tracer® ZN520 Unit Controller



⚠SAFETY WARNING

Only qualified personnel should install and service the equipment. The installation, starting up, and servicing of heating, ventilating, and air-conditioning equipment can be hazardous and requires specific knowledge and training. Improperly installed, adjusted or altered equipment by an unqualified person could result in death or serious injury. When working on the equipment, observe all precautions in the literature and on the tags, stickers, and labels that are attached to the equipment.

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TRANE TECHNOLOGIES™

Introduction

Warnings, Cautions, and Notices

Safety advisories appear throughout this manual as required. Your personal safety and the proper operation of this machine depend upon the strict observance of these precautions.

The three types of advisories are defined as follows:

WARNING	Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.
CAUTION	Indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury. It could also be used to alert against unsafe practices.
NOTICE	Indicates a situation that could result in equipment or property-damage only accidents.

Important Environmental Concerns

Scientific research has shown that certain man-made chemicals can affect the earth’s naturally occurring stratospheric ozone layer when released to the atmosphere. In particular, several of the identified chemicals that may affect the ozone layer are refrigerants that contain Chlorine, Fluorine and Carbon (CFCs) and those containing Hydrogen, Chlorine, Fluorine and Carbon (HCFCs). Not all refrigerants containing these compounds have the same potential impact to the environment. Trane advocates the responsible handling of all refrigerants-including industry replacements for CFCs and HCFCs such as saturated or unsaturated HFCs and HCFCs.

Important Responsible Refrigerant Practices

Trane believes that responsible refrigerant practices are important to the environment, our customers, and the air conditioning industry. All technicians who handle refrigerants must be certified according to local rules. For the USA, the Federal Clean Air Act (Section 608) sets forth the requirements for handling, reclaiming, recovering and recycling of certain refrigerants and the equipment that is used in these service procedures. In addition, some states or municipalities may have additional requirements that must also be adhered to for responsible management of refrigerants. Know the applicable laws and follow them.

WARNING

Proper Field Wiring and Grounding Required!

Failure to follow code could result in death or serious injury. All field wiring MUST be performed by qualified personnel. Improperly installed and grounded field wiring poses FIRE and ELECTROCUTION hazards. To avoid these hazards, you MUST follow requirements for field wiring installation and grounding as described in NEC and your local/state/national electrical codes.

WARNING

Personal Protective Equipment (PPE) Required!

Failure to wear proper PPE for the job being undertaken could result in death or serious injury. Technicians, in order to protect themselves from potential electrical, mechanical, and chemical hazards, MUST follow precautions in this manual and on the tags, stickers, and labels, as well as the instructions below:

- **Before installing/servicing this unit, technicians MUST put on all PPE required for the work being undertaken (Examples; cut resistant gloves/sleeves, butyl gloves, safety glasses, hard hat/bump cap, fall protection, electrical PPE and arc flash clothing). ALWAYS refer to appropriate Safety Data Sheets (SDS) and OSHA guidelines for proper PPE.**
- **When working with or around hazardous chemicals, ALWAYS refer to the appropriate SDS and OSHA/GHS (Global Harmonized System of Classification and Labeling of Chemicals) guidelines for information on allowable personal exposure levels, proper respiratory protection and handling instructions.**
- **If there is a risk of energized electrical contact, arc, or flash, technicians MUST put on all PPE in accordance with OSHA, NFPA 70E, or other country-specific requirements for arc flash protection, PRIOR to servicing the unit. NEVER PERFORM ANY SWITCHING, DISCONNECTING, OR VOLTAGE TESTING WITHOUT PROPER ELECTRICAL PPE AND ARC FLASH CLOTHING. ENSURE ELECTRICAL METERS AND EQUIPMENT ARE PROPERLY RATED FOR INTENDED VOLTAGE.**

WARNING

Follow EHS Policies!

Failure to follow instructions below could result in death or serious injury.

- **All Trane personnel must follow the company's Environmental, Health and Safety (EHS) policies when performing work such as hot work, electrical, fall protection, lockout/tagout, refrigerant handling, etc. Where local regulations are more stringent than these policies, those regulations supersede these policies.**
- **Non-Trane personnel should always follow local regulations.**

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Revision History

Minor updates to document.

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Introduction

This Installation, Operation, and Maintenance manual includes information about the Tracer® ZN520 zone controller. Tracer ZN520 zone controller is the second in the family of controls for terminal products. You can use the Tracer ZN520 zone controller with the following units:

- UniTrane® fan-coil units
- Force-Flo™ cabinet heaters
- UniTrane low vertical fan-coil units
- Blower coil units
- Classroom unit ventilator units

This document describes the features of the Tracer ZN520 zone controller. However, certain applications may not be available on all products due to design constraints. Refer to the literature for the specific equipment for available features and options.

Trane Family of Tracer Zone Controllers

The Trane family of Tracer zone controllers is the next generation of quality equipment controllers designed to meet product-specific requirements. Tracer ZN510 and the Tracer ZN010 were the first controls to support 2-position (on/off) control requirements of 1 heat/1 cool and water source heat pump terminal units.

Tracer ZN520 zone controller replaces the core functions of the terminal zone controller on fan coil, classroom unit ventilator, and blower coil units. To provide better temperature control, Tracer ZN520 zone controller provides:

- Cascade control
- Modulating hydronic valves
- 2-position valves
- One or two stages of electric heat
- Direct expansion (DX) cooling
- Dehumidification
- Economizer damper
- Face/bypass damper
- Baseboard heat

Note: *The Tracer ZN520 zone controller supports hydronic terminal units with two-position valves and dampers, and one stage of electric heat. The Tracer® ZN520 zone controller does not support units with a two-position damper.*

The Trace ZN520 zone controller is applied to the UniTrane fan-coil unit, Force-Flo cabinet heaters, UniTrane® low vertical fan-coil units, and blower coil units, as follows:

UniTrane fan coil:

- FCA vertical concealed
- FCB vertical cabinet
- FCC horizontal concealed
- FCD horizontal cabinet
- FCE horizontal recessed
- FCH vertical recessed
- FCJ vertical slope-top cabinet

Force-Flo cabinet heaters:

- FFA vertical concealed
- FFB vertical cabinet
- FFC horizontal concealed
- FFD horizontal cabinet
- FFE horizontal recessed
- FFF vertical wall-hung
- FFH vertical recessed
- FFJ vertical slope-top cabinet
- FFM inverted vertical cabinet
- FFN inverted vertical recessed

UniTrane low vertical fan coils:

- FCL low vertical cabinet
- FCK low vertical concealed

Blower coils:

- BCH horizontal blower coil
- BCV vertical blower coil

Waco offers the Tracer ZN520 on classroom unit ventilators in horizontal or vertical configurations. Multiple sizes are available in both configurations, as shown in Table 1, p. 8.

Table 1. Classroom unit ventilators: size configurations

Horizontal unit ventilator (HUV)	Vertical unit ventilator (VUV)
750 cfm	750 cfm
1000 cfm	1000 cfm
1250 cfm	1250 cfm
1500 cfm	1500 cfm
2000 cfm	

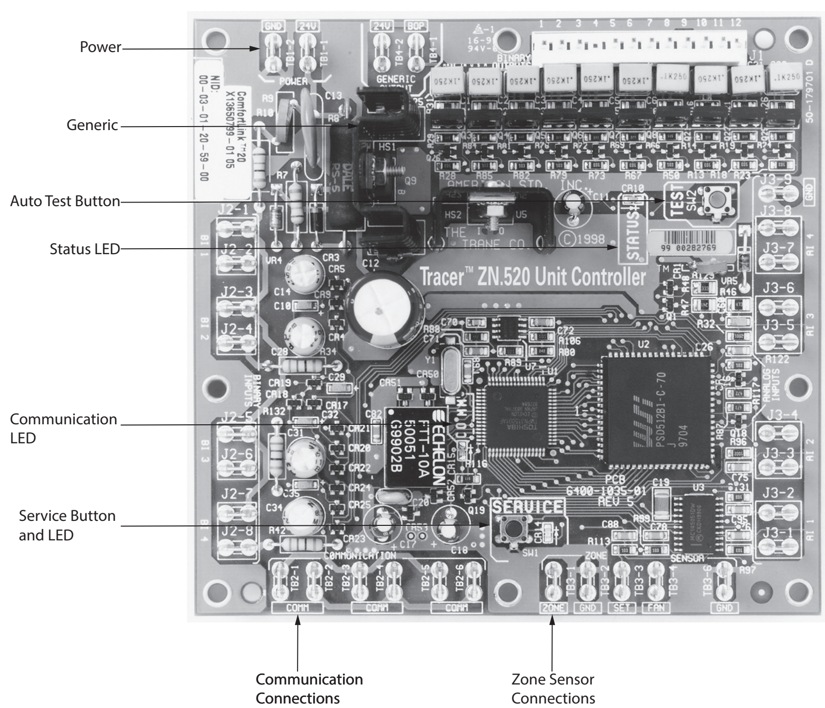
Features and Benefits

Table 2. Tracer ZN520 zone controller features and coil availability

Coil	Multiple fan speeds	Dehumid-ification	Auto damper adjust	Face and bypass damper	Valve control	Economizer damper	Auxiliary heat (a)	Entering water temperature sampling
2-pipe changeover	X		X	X	X	X	X	X
2-pipe hot water only	X		X	X	X	X	X	
2-pipe steam only	X		X	X		X	X	
2-pipe changeover/electric heat	X	X	X		X	X	X	X
2-pipe cool only	X		X		X	X		
2-pipe cool only/electric heat	X(b)		X(b)		X	X	X	
4-pipe hot water/chilled water	X	X	X	X(c)	X	X	X	
4-pipe changeover	X	X	X	X(c)	X	X	X	X
4-pipe steam/chilled water	X		X		X	X	X	
Electric heat only						X	X	
DX/hot water	X(b)		X(b)		X	X	X	
DX/steam	X(b)		X(b)		X	X	X	
DX/electric heat						X	X	
DX cooling only						X		

(a) Auxiliary heat is designed to bring on baseboard heat as the second stage of heating. The baseboard heat must be the same type as the unit heating coil.
(b) Multiple fan speeds are available in hydronic units only.
(c) Units with face bypass dampers cannot actively dehumidify.

Figure 1. Tracer ZN520 zone controller circuit board



Specifications

Board dimensions

- **Height:** 5.25 in. (133 mm)
- **Width:** 5.50 in. (140 mm)
- **Depth:** 2.25 in. (57 mm)

Operating environment

- 32° to 140°F (0° to 60°C)
- 5% to 95% relative humidity, non-condensing

Storage environment

- -40° to 185°F (-40° to 85°C)
- 5% to 95% relative humidity, non-condensing

Agency listings

UL and CUL 916 Energy Management System

Agency compliance

IEC 1000-4-2 (ESD), IEC 1000-4-4 (EFT), IEC 1000-4-5 (Surge)

Power requirements

- 18 to 32 VAC (24 VAC nominal)
- 50 or 60 Hz
- 570 mA AC

Binary Inputs

Table 3. Binary inputs (typically 24 mA AC)

Description	Terminals	Terminal function
Binary input 1 (BI 1)	J2-1	24 VAC
	J2-2	Input
Binary input 2 (BI 2)	J2-3	24 VAC
	J2-4	Input
Binary input 3 (BI 3)	J2-5	24 VAC
	J2-6	Input
Binary input 4 (BI 4)	J2-7	24 VAC
	J2-8	Input

Note: *Each binary input associates an input signal of 0 VAC with open contacts and 24 VAC with closed contacts.*

Binary Outputs

Outputs are load side switching triacs. The triac acts as a switch, either making or breaking the circuit between the load (valve, damper, contactor, relay) and ground.

Table 4. Binary outputs

Description	Terminals	Output rating	Load energized	Load De-energized
Fan high	J1-1	12 VA	1 VAC rms (typical)	24 VAC rms (typical)
Fan medium, Exhaust fan	J1-2	12 VA	1 VAC rms (typical)	24 VAC rms (typical)

Table 4. Binary outputs (continued)

Description	Terminals	Output rating	Load energized	Load De-energized
Fan low	J1-3	12 VA	1 VAC rms (typical)	24 VAC rms (typical)
No connection	J1-4 (Key)	—	—	—
Cool open, face bypass cool valve DX, 2-position cooling valve, BI 5	J1-5	12 VA	1 VAC rms (typical)	24 VAC rms (typical)
Cool close	J1-6	12 VA	1 VAC rms (typical)	24 VAC rms (typical)
Face/bypass damper open	J1-7	12 VA	1 VAC rms (typical)	24 VAC rms (typical)
Face/bypass damper close	J1-8	12 VA	1 VAC rms (typical)	24 VAC rms (typical)
Heat open Face bypass isolation valve, 2-position heating valve Electric heat 1st stage	J1-9	12 VA	1 VAC rms (typical)	24 VAC rms (typical)
Heat close Electric heat 2nd stage	J1-10	12 VA	1 VAC rms (typical)	24 VAC rms (typical)
Economizer damper open	J1-11	12 VA	1 VAC rms (typical)	24 VAC rms (typical)
Economizer damper close	J1-12	12 VA	1 VAC rms (typical)	24 VAC rms (typical)

Table 5. Generic/baseboard heat binary output

Description	Terminals	Output rating	Load energized	Load de-energized
Generic/ baseboard heat output	TB4-1	12 VA	1 VAC rms (typical)	24 VAC rms (typical)
24 VAC	TB4-2	12 VA	NA	NA

Analog Inputs

Table 6. Analog inputs

Description	Terminals	Function	Range
Zone	TB3-1	Space temperature input	5° to 122°F (-15° to 50°C)
Ground	TB3-2	Analog ground	NA
Set	TB3-3	Setpoint input	40° to 115°F (4.4° to 46.1°C)
Fan	TB3-4	Fan switch input	4821 to 4919 Ω (Off) 2297 to 2342 Ω (Auto) 10593 to 10807 Ω (Low) 13177 to 13443 Ω (Medium) 15137 to 16463 Ω (High)
Ground	TB3-6	Analog ground	NA
Analog input 1	J3-1	Entering water temperature	-40° to 212°F (-40° to 100°C)
	J3-2	Analog ground	NA
Analog input 2	J3-3	Discharge air temperature	-40° to 212°F (-40° to 100°C)
	J3-4	Analog ground	NA
Analog input 3	J3-5	Outdoor air temperature/Generic temperature	-40° to 212°F (-40° to 100°C)
	J3-6	Analog ground	NA

Table 6. Analog inputs (continued)

Description	Terminals	Function	Range
Analog input 4	J3-7	Power port	4–20 mA
	J3-8	Universal input Generic 4–20 mA Humidity CO_2	 0–100% 0–100% 0–2000 ppm
	J3-9	Analog ground	NA

Note: Table 25, p. 23 describes the source of the signals for each analog input.

Binary Outputs

General Description

Note: *Refer to* *Table 4, p. 10* *and* *Table 5, p. 11* *for terminal identification and typical usage.*

The Tracer ZN520 zone controller is a high-end modulating controller that supports the economizer and discharge air tempering functions of terminal products. The controller may be configured and applied to fan coil, blower coil, or unit ventilator configurations. The configuration of binary outputs is largely based on the unit configuration. Refer to Table 7, p. 13 for possible functions for each binary output.

Binary outputs are configured to support the following:

- Three fan stages (when one or two fan stages are present, medium fan speed can be configured as exhaust fan)
- One hydronic cooling stage
- One hydronic heating stage (dehumidification requires this to be in the reheat position)
- One DX cooling stage
- One- or two-stage electric heat (dehumidification requires this to be in the reheat position)
- Face and bypass damper
- Modulating outdoor air damper
- One baseboard heat stage

Table 7. Configuration of binary outputs

J1-1	Fan high
J1-2	Fan medium/Exhaust fan
J1-3	Fan low
J1-4	(Key)
J1-5	Cool valve—open, or 2 position valve, or DX compressor output[(a)]
J1-6	Cool valve—close[(a)]
J1-7	Face and bypass damper—open
J1-8	Face and bypass damper—close
J1-9	Heat valve—open, or 2 position valve, or 1st electric heat stage[(a)]
J1-10	Heat valve—close or 2nd electric heat stage[(a)]
J1-11	Outdoor air damper—open
J1-12	Outdoor air damper—close
TB4-1	Generic/Baseboard heat output
TB4-2	24 VAC

(a) For Tracer ZN520 zone controller units configured and applied as 2-pipe hydronic heat/cool changeover, terminals J1-5 and J1-6 are used to control the primary valve for both heating and cooling.

For Tracer ZN520 zone controller units configured and applied as 2-pipe hydronic heat/cool changeover with electric heat, terminals J1-5 and J1-6 are used to control the primary valve (for both cooling and heating), and terminals J1-9 and J1-10 are used only for the electric heat stage.

For those 2-pipe changeover units, electric heat **will not** be energized while the hydronic supply is hot (5 or more degrees above the space temperature).

Table 8, p. 13 to Table 21, p. 18 give example usage of the binary outputs for various configurations.

Table 8. Two-pipe cooling valve control

J1-1	Fan high
J1-2	Fan medium/Exhaust fan
J1-3	Fan low

Table 8. Two-pipe cooling valve control (continued)

J1-1	Fan high
J1-4	(Key)
J1-5	Cool—open
J1-6	Cool—close
J1-7	Not used
J1-8	Not used
J1-9	Not used
J1-10	Not used
J1-11	Outdoor air damper—open
J1-12	Outdoor air damper—close
TB4-1	Generic output
TB4-2	24 VAC

Table 9. Two-pipe cooling valve control with electric heat (1- or 2-stage)

J1-1	Fan high
J1-2	Fan medium/Exhaust fan
J1-3	Fan low
J1-4	(Key)
J1-5	Cool—open
J1-6	Cool—close
J1-7	Not used
J1-8	Not used
J1-9	Electric heat—stage 1
J1-10	Electric heat—stage 2
J1-11	Outdoor air damper—open
J1-12	Outdoor air damper—close
TB4-1	Generic/Baseboard heat output
TB4-2	24 VAC

Table 10. Two-pipe heat valve control

J1-1	Fan high
J1-2	Fan medium/Exhaust fan
J1-3	Fan low
J1-4	(Key)
J1-5	Not used
J1-6	Not used
J1-7	Not used
J1-8	Not used
J1-9	Heat—open
J1-10	Heat—close
J1-11	Outdoor air damper—open
J1-12	Outdoor air damper—close
TB4-1	Generic/Baseboard heat output
TB4-2	24 VAC

Table 11. Two-pipe heat/cool changeover valve control

J1-1	Fan high
J1-2	Fan medium/Exhaust fan
J1-3	Fan low
J1-4	(Key)
J1-5	Heat/cool changeover—open
J1-6	Heat/cool changeover—close
J1-7	Not used
J1-8	Not used
J1-9	Not used
J1-10	Not used
J1-11	Outdoor air damper—open
J1-12	Outdoor air damper—close
TB4-1	Generic/Baseboard heat output
TB4-2	24 VAC

Table 12. Two-pipe heat/cool valve control with electric heat (1- or 2-stage)

J1-1	Fan high
J1-2	Fan medium/Exhaust fan
J1-3	Fan low
J1-4	(Key)
J1-5	Heat/cool changeover—open
J1-6	Heat/cool changeover—close
J1-7	Not used
J1-8	Not used
J1-9	Electric heat—stage 1
J1-10	Electric heat—stage 2
J1-11	Outdoor air damper—open
J1-12	Outdoor air damper—close
TB4-1	Generic/Baseboard heat output
TB4-2	24 VAC

Table 13. Four-pipe heat/cool valve control

J1-1	Fan high
J1-2	Fan medium/Exhaust fan
J1-3	Fan low
J1-4	(Key)
J1-5	Cool—open
J1-6	Cool—close
J1-7	Not used
J1-8	Not used
J1-9	Heat—open
J1-10	Heat—close
J1-11	Outdoor air damper—open
J1-12	Outdoor air damper—close

Table 13. Four-pipe heat/cool valve control (continued)

TB4-1	Generic/Baseboard heat output
TB4-2	24 VAC

Table 14. Four-pipe heat/cool changeover valve control

J1-1	Fan high
J1-2	Fan medium/Exhaust fan
J1-3	Fan low
J1-4	(Key)
J1-5	Heat/cool changeover—open
J1-6	Heat/cool changeover—close
J1-7	Not used
J1-8	Not used
J1-9	Heat—open
J1-10	Heat—close
J1-11	Outdoor air damper—open
J1-12	Outdoor air damper—close
TB4-1	Generic/Baseboard heat output
TB4-2	24 VAC

Table 15. DX cooling control

J1-1	Fan high
J1-2	Fan medium/Exhaust fan
J1-3	Fan low
J1-4	(Key)
J1-5	Cool—DX
J1-6	Not used
J1-7	Not used
J1-8	Not used
J1-9	Not used
J1-10	Not used
J1-11	Outdoor air damper—open
J1-12	Outdoor air damper—close
TB4-1	Generic/Baseboard heat output
TB4-2	24 VAC

Table 16. Two-pipe heating valve control with DX cooling

J1-1	Fan high
J1-2	Fan medium/Exhaust fan
J1-3	Fan low
J1-4	(Key)
J1-5	Cool—DX
J1-6	Not used
J1-7	Not used
J1-8	Not used

Table 16. Two-pipe heating valve control with DX cooling (continued)

J1-9	Heat—Open
J1-10	Heat—Close
J1-11	Outdoor air damper—open
J1-12	Outdoor air damper—close
TB4-1	Generic/Baseboard heat output
TB4-2	24 VAC

Table 17. DX cooling with electric heat

J1-1	Fan high
J1-2	Fan medium/Exhaust fan
J1-3	Fan low
J1-4	(Key)
J1-5	Cool—DX
J1-6	Not used
J1-7	Not used
J1-8	Not used
J1-9	Electric heat—stage 1
J1-10	Electric heat—stage 2
J1-11	Outdoor air damper—open
J1-12	Outdoor air damper—close
TB4-1	Generic/Baseboard heat output
TB4-2	24 VAC

Table 18. Electric heat control

J1-1	Fan High
J1-2	Fan medium/Exhaust fan
J1-3	Fan low
J1-4	(Key)
J1-5	Not used
J1-6	Not used
J1-7	Not used
J1-8	Not used
J1-9	Electric heat—stage 1
J1-10	Electric heat—stage 2
J1-11	Outdoor air damper—open
J1-12	Outdoor air damper—close
TB4-1	Generic/Baseboard heat output
TB4-2	24 VAC

Table 19. Two-pipe heating valve, face/bypass control

J1-1	Fan High
J1-2	Fan medium/Exhaust fan
J1-3	Fan low
J1-4	(Key)

Table 19. Two-pipe heating valve, face/bypass control (continued)

J1-5	Not used
J1-6	Not used
J1-7	Face bypass—open
J1-8	Face bypass—close
J1-9	Heat isolation valve—open/close
J1-10	Not used
J1-11	Outdoor air damper—open
J1-12	Outdoor air damper—close
TB4-1	Generic/Baseboard heat output
TB4-2	24 VAC

Table 20. Two pipe heating/cooling, face/bypass control

J1-1	Fan high
J1-2	Fan medium/Exhaust fan
J1-3	Fan low
J1-4	(Key)
J1-5	Heat/cool changeover isolation valve—open/close
J1-6	Not used
J1-7	Face bypass—open
J1-8	Face bypass—close
J1-9	Not used
J1-10	Not used
J1-11	Outdoor air damper—open
J1-12	Outdoor air damper—close
TB4-1	Generic/Baseboard heat output
TB4-2	24 VAC

Table 21. Four pipe heating/cooling, face/bypass control

J1-1	Fan high
J1-2	Fan medium/Exhaust fan
J1-3	Fan low
J1-4	(Key)
J1-5	Cool isolation valve—open/close
J1-6	Not used
J1-7	Face bypass damper—open
J1-8	Face bypass damper—close
J1-9	Heat isolation valve—open/close
J1-10	Not used
J1-11	Outdoor air damper—open
J1-12	Outdoor air damper—close
TB4-1	Generic/Baseboard heat output
TB4-2	24 VAC

Generic Binary Output/Baseboard Heat Output

Terminals TB4-1 and TB4-2 can be configured for either a generic binary output, or to control baseboard heat.

When configured for a **generic binary output**, the controller does not use the generic binary output as a part of normal control. This output is only controlled by a Trane Tracer Summit™ system (when present) that can issue commands, via communications to the Tracer ZN520 zone controller, to turn the generic output on and off.

For all configurations, all other binary outputs can only be used for their defined function and **cannot** be used for any other function, such as generic applications. Additionally, if a binary output is defined as Not Used, it **cannot** be applied generically and must remain unused.

When configured for **baseboard heat output**, the controller turns on the baseboard heat at 2.2°F below the active heating setpoint and turns it off at 0.8°F below the active heating setpoint. The range for activating the baseboard heat cannot be adjusted; however, the heating setpoint can be changed using a Rover™ service tool or a Tracer Summit system.

Baseboard heating is most effectively used when the discharge air temperature control high limit is adjusted to a moderately warm temperature. The unit heat can maintain the space on light load days, and the baseboard heat will activate on heavier load days to maintain zone comfort.

Output Overrides

The Tracer ZN520 zone controller includes a manual output test function. This function can be initiated either by depressing the blue Test push button on the controller or via communications using the manual test variable. Use this feature to manually exercise the outputs in a defined sequence. For more information about the manual output test function, see “Manual Output Test” on page 51.

The Tracer ZN520 zone controller contains a water valve override function that can be used for water balancing. A communicating device, such as the Rover service tool, controls this function. The water valve outputs are driven open or closed. For more information about the water balancing function, see “Water Valve Override” on page 51.

Analog Outputs

The Tracer ZN520 zone controller does **not** include analog output capability.

Binary Inputs

Note: *Refer to Table 3, p. 10 for terminal identification.*

The Tracer® ZN520 zone controller has four available binary inputs. Normally, these inputs are factory-configured for the following functions:

- Binary input 1: Low coil temperature detection (freezestat)
- Binary input 2: Condensate overflow
- Binary input 3: Occupancy or generic
- Binary input 4: Fan status

You can configure each of the four binary inputs as normally open or normally closed. The controller will be set properly for each factory-supplied binary input end-device. When no device is connected to the input, configure the controller's input as Not Used.

Note: *Each binary input's default configuration (including normally open/closed) is set at the factory.*

The diagnostic functions related to these binary inputs (i.e., low temperature, condensate overflow, and fan status) are fixed. See Table 22, p. 20 for binary input functions. Configure binary input 3 either as Occupancy or as a Generic binary input. When configured as a generic input, it does not affect controller operation.

Example: A Condensate Overflow diagnostic always disables the unit fan and closes the water valve and outdoor air damper (when present). The generic binary output (when present) is not affected by diagnostics.

Note: *Any binary input not in use (no device is physically connected) should be configured as Not Used.*

Table 22. Binary input configurations

Binary Input	Description	Configuration	Contact closed	Contact open
BI 1	Low coil temperature detection (coil freezestat)[a]	Normally closed	Normal	Diagnostic[b]
BI 2	Condensate overflow[a]	Normally closed	Normal	Diagnostic[b]
BI 3	Occupancy	Normally open	Unoccupied	Occupied
BI 3	Generic binary input	Normally open	Normal[c]	Normal[c]
BI 4	Fan status[a]	Normally open	Normal	Diagnostic[d]

Note: The occupancy binary input is used for stand-alone zone controllers as an occupied/unoccupied input. However, when the controller receives a communicated occupied/unoccupied request, the communicated request has priority over the hardwired input. For additional information, see "Occupied and Unoccupied Operation," p. 35.

(a) During Low Coil Temperature, Condensate Overflow, and fan status (Low AirFlow—Fan Failure) diagnostics, the Tracer ZN520 zone controller control disables all normal unit operation of the fan, valves, and damper.
(b) Table 61, p. 69 shows the controller's response to Low Coil Temperature, Condensate Overflow, and fan status (Low AirFlow — Fan Failure) diagnostics.
(c) The generic binary input does not affect unit operation. A building automation system reads this input as a generic binary input.
(d) See Table 61, p. 69.

Condensate Overflow

A condensate overflow float switch detects a condensate overflow condition. The condensate overflow switch is physically connected to a binary input of the controller (BI 2). When the condensation reaches the trip point, the binary input detects the diagnostic condition. By default, a condensate overflow signal will generate a diagnostic that disables fan operation, closing all unit water valves (when present), disabling the DX compressor (when present), turning off any electric heat (when present), and closing the economizer outdoor air damper (when present). The condensate overflow diagnostic does **not** affect the generic binary output (when present). Although the actual condensate overflow switch automatically resets when the condensation returns to a normal level, manually reset the condensate overflow diagnostic to clear the diagnostic from the controller and restart the unit.

Note: *The condensate overflow switch in the condensate pan automatically resets when the condensation returns to normal levels. However, you must manually reset the controller to clear the condensate overflow diagnostic and restart the unit.*

Low Coil Temperature Detection

Low coil temperature detection protects the coil for hydronic/steam units. A binary input and a low temperature detection device (or freezestat) detects the low temperature signal. The ComfortLink zone controller can protect the coil with one binary input. When the controller detects the low temperature detection signal, the controller generates a diagnostic that disables the fan, opens all unit water valves, and closes the economizer outdoor air damper (when present). The low coil temperature detection diagnostic does **not** affect the generic binary output (when present). Even though the actual low coil temperature detection device automatically resets when the coil/heat exchanger temperature returns to a normal value, you must manually reset the low coil temperature detection diagnostic to clear the diagnostic from the controller and restart the unit.

Note: *The low temperature detection device automatically resets when the coil temperature returns to normal. However, you must manually reset the low coil temperature detection diagnostic to clear the diagnostic and restart the unit.*

Fan Status

The fan status switch protects the unit in belt drive or unit ventilator applications. A Low AirFlow—Fan Failure diagnostic is detected when the control is commanding the fan On and the fan status switch has been open for one minute, or if the fan status switch does not close the binary input within one minute of the controller commanding the fan On. This is a latching diagnostic and discontinues unit operation until the diagnostic has been cleared from the controller. The Low AirFlow—Fan Failure diagnostic does **not** affect the generic binary output (when present). Additional details can be found in "Diagnostics," p. 67.

Note: *The controller includes an automatic diagnostic reset function in which the controller attempts to automatically recover from the low coil temperature detection diagnostic. For more information on the automatic diagnostic reset function, refer to* *"Resetting Diagnostics," p. 68**.*

Occupancy

The Tracer ZN520 zone controller uses the occupancy binary input for two occupancy-related functions. For stand-alone controllers (any unit not receiving a communicated occupancy request, typically from a building automation system such as Tracer Summit), the occupancy binary input determines the unit's occupancy based on the hardwired signal. Normally, the signal is hardwired to a binary switch or clock.

When a hardwired occupancy signal is open, the unit switches to occupied mode (if the occupancy input is configured as normally open). When a hardwired occupancy signal is closed, the controller switches to unoccupied mode.

For controllers that receive a communicated occupancy request (typically from a building automation system such as Tracer Summit), the hardwired occupancy binary input, along with the communicated occupancy request, places the controller in either occupied mode or occupied standby mode.

In occupied mode, the controller operates according to the occupied setpoints. In occupied standby mode, the zone controller operates according to the occupied standby setpoints. When the controller receives a communicated unoccupied request, the controller operates according to the unoccupied setpoints regardless of the state of the hardwired occupancy input.

When neither the binary input nor the communicated input is used to select the occupancy mode, the controller defaults to occupied mode because the occupancy binary input (if present) typically is configured as normally open and no occupancy device is connected.

Table 23, p. 21 and Table 24, p. 22 describe the combination of communication requests and the hardwired input upon the occupancy state of the control.

Table 23. Normally open hardwired input configuration (BI 3)

Description	Communicated request	Hardwired state	Result
Stand-alone	NA	Open = Occupied	Occupied
Stand-alone	NA	Closed = Unoccupied	Unoccupied
Communicating	Occupied	Open = Occupied	Occupied

Table 23. Normally open hardwired input configuration (BI 3) (continued)

Description	Communicated request	Hardwired state	Result
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 24. Normally closed hardwired input configuration (BI 3)

Description	Communicated request	Hardwired state	Result
Stand-alone	NA	Closed = Occupied	Occupied
Stand-alone	NA	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

Generic Binary Input

The generic binary input can be used in a variety of applications using Trane Tracer Summit only. The binary input does **not** affect controller operation. Binary input 3 (BI 3) can be configured as Occupancy or Generic. A generic binary input can be monitored only from Tracer Summit.

Defrost

For direct expansion (DX) compressor cooling applications, a defrost-sensing device is placed in the coil to indicate and help prevent possible frost conditions. The defrost-sensing device disables the Tracer ZN520 zone controller compressor operation when a frost condition exists by opening the controller's triac compressor output circuit. The compressor cannot run because the open circuit prevents the compressor relay from energizing. The Tracer ZN520 zone controller control senses the open triac circuit and commands the triac output off. Fan and economizer damper operation continue to operate, defrosting the coil. The control reports a Defrosting—Cmpr Lockout informational diagnostic when the compressor is disabled by the defrost condition.

The defrost-sensing device automatically resets when the coil temperature returns to a normal value, closing the compressor triac output circuit. The Tracer ZN520 zone controller control senses the defrost device reset and immediately returns to normal cooling control, clearing the defrosting and compressor lockout status, and sending out a Normal diagnostic message. The minimum off time for DX compressors is obeyed, so the compressor may not turn on immediately when the defrost condition ends.

Analog Inputs

Table 25. Analog inputs

Analog Input	Description	Application
Zone	Space temperature	Space temperature
Set	Local setpoint	Zone sensor thumbwheel setpoint
Fan	Fan mode input	Zone sensor fan switch
Analog Input 1 (AI 1)	Entering water temperature	Entering water temperature
Analog Input 2 (AI 2)	Discharge air temperature	Discharge air temperature
Analog Input 3 (AI 3)	Outdoor air temperature or Generic temperature	Outdoor air temperature or Generic temperature (thermistor)
Analog Input 4 (AI 4)	Universal 4–20 mA input	General purpose 4–20 mA input, relative humidity, or CO2 sensor

Note: Refer to Table 6, p. 11 for terminal identification.

Space Temperature

Note: *The Tracer ZN520 zone controller cannot operate without either a valid hardwired or communicated space temperature. When either input returns to a valid value, the controller automatically allows the unit to resume operation.*

The space temperature analog input (zone temperature) measures space temperature only. The space temperature is measured with a 10 kΩ thermistor included with standard Trane zone sensors. The Tracer ZN520 zone controller receives the space temperature from either a wired zone sensor or communicated value.

Once a valid space temperature is established either through the hardwired input or through communication, and when neither a local space temperature nor communicated space temperature is present, the controller generates a Space Temperature Failure diagnostic.

Local Setpoint

The local setpoint input is the local (hardwired) setpoint input only. The local setpoint is a resistive input for use with Trane zone sensors. If neither a hardwired nor communicated setpoint is present, the controller uses the stored default configured heating and cooling setpoints:

- Occupied setpoints
- Occupied standby setpoints
- Unoccupied setpoints

Once a valid setpoint is established through the hardwired input and the local setpoint is no longer present, the controller generates a Local Setpoint Failure diagnostic.

Once a valid fan mode is established through the hardwired input and that local fan mode is no longer present, the controller generates a Local Fan Mode Failure diagnostic.

When a Local Setpoint Failure diagnostic occurs, the controller operates using the default heating and cooling setpoints. These setpoints are factory configured, but may be changed using Trane's Rover service tool.

Note: *The Rover service tool allows you to monitor, configure, and test Tracer ZN520 zone controller zone controllers via a connection to the communication link, directly to the controller (stand-alone) or through communication connection on standard Trane sensors.*

The Tracer ZN520 zone controller uses the following validation sequence for the zone temperature setpoints:

1. Check for a communicated setpoint. If present, validate this setpoint.
2. Check for a hardwired setpoint. If present, validate this setpoint.
3. Use the default setpoints if neither the hardwired setpoint nor the communicated setpoint is available.

Fan Mode Input

Note: *If the Tracer ZN520 zone controller does not receive a hardwired or communicated request for fan mode, the unit recognizes the fan input as auto and the fan operates according to the default fan configuration.*

The fan mode analog input (Fan) operates only as a fan mode switch input with Trane zone sensors. Typically, the fan mode switch on a Trane zone sensor generates the fan mode signal.

The Tracer ZN520 zone controller detects the unique resistance corresponding to each position of the fan switch. By measuring this resistance, the controller determines the requested fan mode.

Table 26, p. 24 describes the controller operation for all fan modes.

Table 26. Tracer ZN520 zone controller fan modes

Fan modes	Tracer ZN520 zone controller operation
Off	Fan Off
Auto	In occupied mode, the fan runs continuously at the default speed if configured as Off, Low, Medium, or High (defined in unit configuration). You can define different speeds for heating and cooling. If the default fan speed is Auto, then the fan may switch speeds, depending on the temperature error. If the cool default is Auto, then when cooling, the fan speed increases as space temperature increases above the active cooling setpoint. If the heat default is Auto, then when heating, the fan speed increases as space temperature decreases below the active heating setpoint. In unoccupied mode, the fan cycles Off when no heating or cooling is required and switches to High when heating or cooling is delivered.
High	In the occupied mode, the fan runs continuously in High speed. In the unoccupied mode, the fan cycles between Off and High when heating or cooling is delivered.
Medium	In the occupied mode, the fan runs continuously in Medium speed. In the unoccupied mode, the fan cycles between Off and High when heating or cooling is delivered.
Low	In the occupied mode, the fan runs continuously in Low speed. In the unoccupied mode, the fan cycles between Off and High when heating or cooling is delivered.

Table 27, p. 24 identifies the fan speed to select with various fan modes and unit configurations.

Table 27. Fan modes supported by the Tracer ZN520 zone controller

Fan mode	Single fan speed unit	Two fan speed unit	Three fan speed unit
Off	Off	Off	Off
Auto	High	Auto	Auto
Low	—	Low	Low
Medium	—	—	Medium
High	High	High	High

Entering Water Temperature

The Tracer® ZN520 zone controller uses analog input 1 (AI 1) as the entering water temperature input for use with a 10 kΩ thermistor only. This analog input is factory-configured as an entering water temperature input, as required. When a valid entering water temperature input exists (either hardwired to AI 1 or communicated), the controller automatically uses this value for heat/cool changeover decisions when entering water input is required. Refer to “Entering Water Temperature Sampling Function,” p. 44.

Once a valid entering water temperature is established through the hardwired input and that the entering water temperature input is no longer valid, the controller generates an Entering Water Temperature Failure diagnostic.

Discharge Air Temperature

Note: *The Tracer ZN520 zone controller cannot operate without a valid discharge air temperature input. When the sensor returns to a valid value, the controller automatically allows the unit to resume operation.*

The Tracer ZN520 zone controller uses analog input 2 (AI 2) as the discharge air temperature input with a 10 kΩ thermistor only. This sensor is hardwired and typically located downstream from all unit heating/cooling capacity at the unit discharge area. 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 Air Temp Failure diagnostic and performs a unit shutdown. When the sensor returns to a valid input, the controller automatically allows the unit to resume operation.

Outdoor Air Temperature

Analog input 3 (AI 3) is used for outdoor air temperature or alternatively as a generic temperature input (10 kΩ thermistor only). When configured as an outdoor air temperature input and when a valid outdoor air temperature exists (either hardwired or communicated), the controller uses this value to determine if economizing (free cooling) is feasible if the controller should enter freeze avoidance during unoccupied periods.

If the outdoor air temperature is below the economizer enable point (adjustable), then economizing is allowed. If the outdoor air temperature is not present, then economizing is not allowed. If both the hardwired and communicated outdoor air temperatures are present, the controller uses the communicated value for control decisions. Once an outdoor air temperature has been established (either hardwired or communicated), the controller generates an Outdoor Air Temp Failure diagnostic if the signal is no longer valid, and the unit disallows economizing.

A value of Enable or Disable for *nviEconEnable* overrides these decisions, regardless of the presence of an outdoor air temperature value.

Economizing is disabled in the DX mode. Refer to “DX Operation,” p. 51.

Generic Temperature Input

Analog input 3 (AI 3) is normally used for outdoor air temperature or alternatively as a generic temperature input (10 kΩ thermistor only). When configured as a generic temperature input, the input can be used in a variety of applications using Tracer Summit. This input has no effect on the controller’s operation but will report a Generic Temperature Failure diagnostic message if the input becomes invalid or out of range.

Universal 4–20 mA Input

Analog input 4 (AI 4) can be configured for one of three functions. See Table 28.

Table 28. Use of analog input 4 as a universal 4–20 mA input

AI 4 configuration	Range	Application
Generic 4–20 mA	0–100%	Useful only for Tracer Summit systems. There is no effect on the operation of the controller.
Relative humidity	0–100%	Measurement of RH for dehumidification control of the space. NOT to be used for outdoor RH sensing.
CO_2	0–2000 ppm	Useful only for Tracer Summit systems. There is no effect on the operation of the controller.

Generic 4–20 mA Input

When configured as a generic input, the input can be used in a variety of applications using Tracer Summit only. This input has no effect on the operation of the controller. After a valid value has been detected and is no longer valid, the controller generates a Generic AIP Failure informational diagnostic.

Relative Humidity Input

When configured as an relative humidity input and when a valid relative humidity value exists (either hardwired or communicated), the controller can use this value to support the dehumidification function.

If both the hardwired and communicated relative humidity values are present, the controller uses the communicated value for control decisions. Once a relative humidity value is established (either hardwired or communicated), the controller generates a Humidity Input Failure diagnostic if the signal is no longer valid, and disables dehumidification.

CO_2

When configured to measure CO_2, the input can be used in a variety of applications using Tracer Summit. This input has no effect on the operation of the controller. After a valid value has been detected and is no longer valid, the controller generates a CO_2 Sensor Failure informational diagnostic.

Zone Sensors

The Tracer ZN520 zone controller accepts the following zone sensor module inputs:

- Space temperature measurement (10 kW thermistor)
- Local setpoint (either internal or external on the zone sensor module)
- Fan switch
- Timed override (On) and Cancel timed override
- Communication jack

Space Temperature Measurement

Trane zone sensors use a 10 kW thermistor to measure the space temperature. Typically, zone sensors are wall-mounted in the room and include a space temperature thermistor. As an option, the zone sensor can be unit-mounted with a separate space temperature thermistor located in the unit's return air stream.

If both a hardwired and communicated space temperature value exist, the controller ignores the hardwired space temperature input and uses the communicated value.

Internal and External Setpoint Adjustment

Zone sensors with an internal or external setpoint adjustment (1 kW) provide the Tracer ZN520 zone controller with a local setpoint (50°F to 85°F or 10°C to 29.4°C). The internal setpoint adjustment is concealed under the zone sensor’s cover. To reveal the adjustable setpoint wheel, remove the zone sensor cover. The external setpoint (when present) is exposed on the zone sensor’s front cover.

When the hardwired setpoint adjustment is used to determine the setpoints, all unit setpoints are calculated based on the hardwired setpoint value, the configured setpoints, and the active mode of the controller.

Example: Assume the controller is configured with the following default setpoints:

Unoccupied cooling setpoint	85°F
Occupied standby cooling setpoint	76°F
Occupied cooling setpoint	74°F
Occupied heating setpoint	70°F
Occupied standby heating setpoint	66°F
Unoccupied heating setpoint	60°F

Absolute setpoint offset = setpoint input – mean setpoint

From the default setpoints in this example, the mean of the occupied cooling and heating setpoints is 72°F [(74+70) / 2]. The absolute setpoint offset is the difference between the setpoint input and the mean setpoint. For this example, assume a setpoint input of 73°F, resulting in an absolute setpoint offset of one degree (73 –72=1).

Note: *The hardwired setpoint is used with the controller's occupancy mode (occupied, occupied standby, or unoccupied), the heating or cooling mode, the temperature deadband values, and the heating and cooling setpoints (high and low limits) to determine the controller's active setpoint.*

The controller adds the absolute setpoint offset to occupied and occupied standby default setpoints to derive the effective setpoints as follows:

Unoccupied cooling setpoint	85°F (same as default)
Occupied standby cooling setpoint	77°F (default+1=77)
Occupied cooling setpoint	75°F (default+1=75)
Occupied heating setpoint	71°F (default+1=71)
Occupied standby heating setpoint	67°F (default+1=67)
Unoccupied heating setpoint:	60°F (same as default)

The Tracer ZN520 zone controller determines the effective setpoint based on the following:

- Communicated setpoint input
- Communicated setpoint offset
- Hardwired setpoint input
- Default setpoints
- Occupancy mode
- Heating or cooling mode
- Setpoint high and low limits

When a building automation system or other controller communicates a setpoint to the controller, the controller ignores the hardwired setpoint input and uses the communicated value. The exception is the unoccupied mode, when the controller always uses the stored default unoccupied setpoints.

After the controller completes all setpoint calculations, based on the requested setpoint, the occupancy mode, the heating and cooling mode, and other factors, the calculated setpoint is validated against the following setpoint limits:

- Heating setpoint high limit
- Heating setpoint low limit
- Cooling setpoint high limit
- Cooling setpoint low limit

These setpoint limits only apply to the occupied and occupied standby heating and cooling setpoints. These setpoint limits do not apply to the unoccupied heating and cooling setpoints stored in the controller's configuration.

Note: *When the controller is in unoccupied mode, it always uses the stored unoccupied heating and cooling setpoints.*

The unit can also be configured to enable or disable the local (hardwired) setpoint. This parameter provides additional flexibility to allow you to apply communicated, hardwired, or default setpoints without making physical changes to the unit.

Similar to hardwired setpoints, the effective setpoint value for a communicated setpoint is determined based on the stored default setpoints (which determines the occupied and occupied standby temperature deadbands) and the controller's occupancy mode.

Fan Switch

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 hardwired fan switch input and uses the communicated value.

The zone sensor fan switch input can be enabled or disabled through configuration using the Rover service tool. If the zone sensor switch is disabled, the controller resorts 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 outputs are driven to the Closed position.

Upon a loss of signal on the fan speed input, the controller reports a Local Fan Mode Failure diagnostic and reverts to using the default fan speed.

On/Cancel Buttons

Momentarily pressing the On button during unoccupied mode places the controller in occupied bypass mode for 120 minutes. You can adjust the number of minutes in the zone controller configuration using Rover service tool. The controller remains in occupied bypass mode until the override time expires or until you press the Cancel button.

Communication Jack

Use the RJ-11 communication jack (present on some zone sensor modules) as the connection point from Rover service tool to the communication link—when the communication jack is wired to the communication link at the controller. By accessing the communication jack via Rover, you gain access to any controller on the link.

Zone Sensor Wiring Connections

Table 29. Typical Trane zone sensor wiring connections

TB1	Description
1	Space temperature
2	Common
3	Setpoint
4	Fan mode
5	Communications
6	Communications

Communications

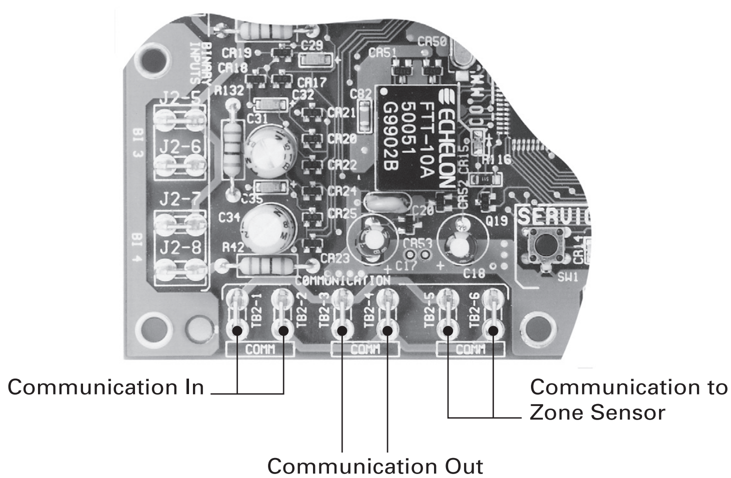
The Tracer ZN520 zone controller communicates via Trane’s Comm5 protocol. Typically, a communication link is applied between zone controllers and a building automation system. Communication also is possible via Rover, Trane's service tool. Peer-to-peer communication across controllers is possible even when a building automation system is not present.

Note: *You do not need to observe polarity for Comm5 communication links.*

The controller provides six 0.25 inch quick-connect terminals for the Comm5 communication link connections, as follows:

- Two terminals for communication to the board
- Two terminals for communication from the board to the next unit (daisy chain)
- Two terminals for a connection to the zone sensor (RJ-11) jack from to the controller

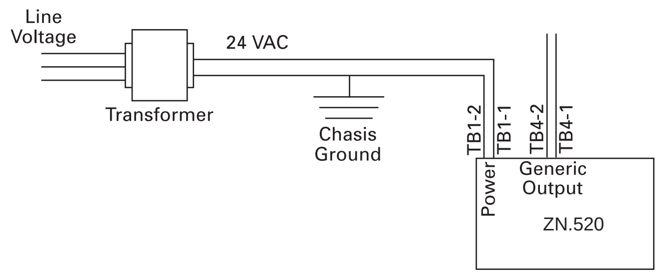
Figure 2. Communication wiring



Power

The Tracer ZN520 zone controller is powered by 24 VAC. Two 0.25-inch quick-connect terminals are provided for 24 VAC connection to the board.

Figure 3. Tracer ZN520 zone controller power requirement



Note: *Board terminals TB4-1 and TB4-2 are connections for the Tracer ZN520 zone controller generic binary output, or baseboard heat control. These connections are not extra power terminals.*

Input/Output Summary

The Tracer ZN520 zone controller includes the following input and output points:

- Power:

  24 VAC NEC Class 2 TB1-1, TB1-2
- Four binary inputs:
  - Low coil temperature detection J2-1, J2-2
  - Condensate overflow J2-3, J2-4
  - Occupancy (or generic binary input) J2-5, J2-6
  - Fan status (differential pressure switch) J2-7, J2-8
- 12 binary outputs, based on the application and unit configuration:
  - High fan speed J1-1
  - Medium fan speed or exhaust fan J1-2
  - Low fan speed J1-3
  - Cool, heat/cool changeover modulate open, 2 position cool, DX cooling J1-5
  - Cool, heat/cool changeover modulate close J1-6
  - Face/bypass damper modulate to face J1-7
  - Face/bypass damper modulate to bypass J1-8
  - Heat modulate open, 2 position heat, 1st stage of electric heat J1-9
  - Heat modulate close, 2nd stage of electric heat J1-10
  - Damper modulate open J1-11
  - Damper modulate close J1-12
  - Generic/baseboard heat binary output TB4-1, TB3-1
- Seven analog inputs:
  - Space temperature (timed override and cancel) TB3-1
  - Space temperature setpoint (thumbwheel) TB#-3
  - Fan mode input TB3-4
  - Entering water temperature J3-1, J3-2
  - Discharge air temperature J3-3, J3-4
  - Outdoor air temperature (or generic temperature input) J3-5, J3-6
  - Universal 4-20mA (generic 4-20 mA, relative humidity, or CO2)
  - J3-7, J3-8, J3-9
- Comm5 communications TB2-1, TB2-2; TB2-3, TB2-4; TB2-5, TB2-6

Sequence of Operation

The Tracer ZN520 zone controller is factory-configured in a variety of heating-only units, cooling-only units, and heating and cooling terminal units. The controller supports the following configuration options.

Fan	One-, two-, or three-speed fan (exhaust fan optional on one- or two-speed units)
Cooling	Modulating hydronic, 2-position hydronic, economizer, DX (direct expansion) compressor
Heating	Modulating hydronic, 2-position hydronic, baseboard heat, one or two stages of electric heat, steam

Note: *The Tracer ZN520 zone controller does not support a 2-position outdoor air damper.*

The Tracer ZN520 zone controller controls the space temperature according to the active space temperature, the active heating/cooling setpoint, discharge air temperature, and the control algorithm. The space temperature and active heating/cooling setpoint determine the operating mode of the controller (heat or cool).

The active heating and cooling setpoints are affected by the controller's occupancy mode. Valid occupancy modes are:

- Occupied
- Unoccupied
- Occupied standby
- Occupied bypass

Note: *By default, if no occupancy binary input or communicated occupancy request exists, the Tracer ZN520 zone controller runs in occupied mode.*

The controller's occupancy mode is determined by either a binary input to the controller or a communicated request (from a system-level controller or another peer controller).

The controller uses the measured space temperature, discharge air temperature, and the control algorithm to maintain the space temperature at the active cooling setpoint (in cooling mode) or the active heating setpoint (in heating mode). This algorithm utilizes proportional/integral (PI) control for maintaining the space temperature. The controller's heat/cool mode is determined by either a communicated request or by the controller itself when the heat/cool mode is auto.

If the Tracer ZN520 zone controller determines its heat/cool mode automatically, the controller changes to the requested mode based on the heating and cooling capacity determined by the control algorithm. For 2-pipe and 4-pipe changeover applications (valid entering water temperature is required), the entering water temperature is provided with either a communicated or hardwired connection to the controller.

Power-up Sequence

Note: *Manual output test can be initiated at any time in the power-up sequence or during normal operation.*

When 24 VAC power is initially applied to the controller, the following sequence occurs:

- Green Status LED turns on.
- All outputs are controlled Off.
- The controller reads input values to determine initial values.
- Stand-alone control is assumed unless occupancy data is communicated.
- Random start timer expires (5 to 30 seconds, random).
- Power-up control Wait feature is applied. When power-up control wait is enabled, the controller waits 120 seconds to allow ample time for communicated control data to arrive. If, after 120 seconds, the controller does not receive a communicated occupancy request, the unit assumes stand-alone operation.
- All modulating valves and damper calibrate closed, face and bypass damper calibrate to bypass (when present).

- Normal operation begins after 290 (potentially) seconds have passed.

Note: *Manual output test can be initiated at any time. Refer to the* *"Manual Output Test," p. 65**.*

Setpoint Operation

The controller has three sets of possible heating and cooling setpoints:

- Occupied
- Occupied standby
- Unoccupied

Note: *In unoccupied mode, the controller always uses locally stored default unoccupied heating and cooling setpoints. These setpoints are configured during factory download and unit verification. Use Rover service tool to modify these default unoccupied setpoints.*

Setpoint Selection

Internal and External Setpoint Adjustment

Zone sensors with an internal or external setpoint adjustment (1 kW) provide the Tracer ZN520 zone controller with a local setpoint (50 to 85°F or 10 to 29.4°C). The internal set point adjustment is concealed under the zone sensor's cover. To reveal the adjustable setpoint wheel, remove the zone sensor cover. The external setpoint (when present) is exposed on the zone sensor's front cover.

When the hardwired setpoint adjustment is used to determine the setpoints, all unit setpoints are calculated based on the hardwired setpoint value, the configured setpoints, and the active mode of the controller.

Example: Assume the controller is configured with the following default setpoints:

Unoccupied cooling setpoint	85ºF
Occupied standby cooling setpoint	76ºF
Occupied cooling setpoint	74ºF
Occupied heating setpoint	70ºF
Occupied standby heating setpoint	66ºF
Unoccupied heating setpoint	60ºF

Absolute setpoint offset = setpoint input – mean setpoint

From the default setpoints in this example, the mean of the occupied cooling and heating setpoints is 72ºF (74 +70÷2). The absolute setpoint offset is the difference between the setpoint input and the mean setpoint. For this example, assume a setpoint input of 73ºF, resulting in an absolute setpoint offset of one degree (73–72=1).

Note: *The hardwired setpoint is used with the controller's occupancy mode (occupied, occupied standby, or unoccupied), the heating or cooling mode, the temperature deadband values, and the heating and cooling setpoints (high and low limits) to determine the controller's active setpoint.*

The controller adds the absolute setpoint offset to occupied and occupied standby default setpoints to derive the effective setpoints. The controller adds the absolute setpoint offset to occupied and occupied standby default setpoints to derive the effective setpoints as follows.

Unoccupied cooling setpoint	85ºF (same as default)
Occupied standby cooling setpoint	77ºF (default + 1 = 77)
Occupied cooling setpoint	75ºF (default + 1 = 75)
Occupied heating setpoint	71ºF (default + 1 = 71)
Occupied standby heating setpoint	67ºF (default + 1 = 67)

Unoccupied heating setpoint	60ºF

The ZN520 controller determines the effective setpoint based on the following:

- Hardwired setpoint input
- Communicated setpoint input
- Communicated setpoint offset
- Default setpoints
- Occupancy mode
- Heating or cooling mode
- Setpoint high and low limits

When a building automation system or other controller communicates a setpoint to the controller, the controller ignores the hardwired setpoint input and uses the communicated value. In unoccupied mode, the exception, the controller always uses the stored default unoccupied setpoints.

Note: *When the controller is in unoccupied mode, it always uses the stored unoccupied heating and cooling setpoints.*

After the controller completes all setpoint calculations, based on the requested setpoint, the occupancy mode, the heating and cooling mode, and other factors, the calculated setpoint is validated against the following setpoint limits:

- Heating setpoint high limit
- Heating setpoint low limit
- Cooling setpoint high limit
- Cooling setpoint low limit

These setpoint limits only apply to the occupied and occupied standby heating and cooling setpoints. These setpoint limits do not apply to the unoccupied heating and cooling setpoints stored in the controller's configuration.

Unit configuration also exists to enable or disable the local (hardwired) setpoint. This parameter provides additional flexibility to allow you to appy communicated, hardwired, or default setpoints without making physical changes to the unit.

Table 30. Setpoint operation

Method	Used in the following situations
Zone sensor (with an adjustable hardwired setpoint)	A hardwired, adjustable setpoint is connected to the controller. Local setpoints are enabled in the unit configuration. No communicated setpoint is present.
Communicated source	A setpoint is communicated to the zone controller, typically from a building automation system or a peer controller. If both a hardwired setpoint and a communicated setpoint exist, the controller uses the communicated value. The configuration feature for enabling/disabling the local setpoint does not affect the setpoint handling when communicated setpoints are used. The communicated setpoint always takes priority over the hardwired setpoint, even when the local setpoint is enabled.
Stored default setpoints	The controller uses the locally stored default heating and cooling setpoints when neither a local hardwired setpoint nor communicated setpoint is present. The controller uses stored default setpoints when only a local setpoint exists, but the local setpoint is disabled in the configuration of the controller. The controller always uses the stored default (unoccupied) setpoints in unoccupied mode.

Occupied and Unoccupied Operation

The valid occupancy modes of the Tracer ZN520 zone controller are:

- **Occupied**—Normal operating mode for occupied spaces or daytime operation.
- **Unoccupied**—Normal operating mode for unoccupied spaces or nighttime operation.

- **Occupied standby**—Mode used to reduce the heating and cooling operation during the occupied hours when the space is vacant or unoccupied and adjusts ventilation rate (OA damper). For example, the controller may use occupied standby mode for a classroom while the students are out of the room.
- **Occupied bypass**—Mode used for timed override conditions. For example, if the controller is in unoccupied mode and someone presses the On button on the zone sensor, the controller is placed in occupied bypass mode for 120 minutes (adjustable) or until someone presses the Cancel button on the zone sensor.

The occupancy mode can be hardwired to the controller via the occupancy binary input or communicated to the controller.

Occupied Mode

When the controller is in the occupied mode, the unit attempts to maintain the space temperature at the active occupied heating or cooling setpoint, based on the measured space temperature, the discharge air temperature, the active setpoint, and the proportional/integral control algorithm. The modulating control algorithm used when in occupied or occupied standby is described in the following sections. Additional information related to the handling of the controller setpoints can be found in “Setpoint Operation,” p. 34.

Unoccupied Mode

When the controller is in the unoccupied mode, the controller attempts to maintain the space temperature at the stored unoccupied heating or cooling setpoint, based on the measured space temperature, the active setpoint and the control algorithm, regardless of the presence of a hardwired or communicated setpoint. Similar to other configuration properties of the controller, the locally stored unoccupied setpoints can be modified using Rover service tool.

In unoccupied mode, a simplified zone control algorithm is run. During the cooling mode, when the space temperature is above the cool setpoint, the primary cooling capacity operates at 100%. If more capacity is needed, the supplementary cooling capacity turns on (or opens to 100%). During the heating mode, when the space temperature is below the heat setpoint, the primary heating capacity turns on. All capacity is turned off when the space temperature is between the unoccupied cooling and heating setpoints. Note that primary heating or cooling capacity is defined by unit type and whether heating or cooling is enabled or disabled. For example, if the economizer is enabled and possible, it will be the primary cooling capacity. If hydronic heating is possible, it will be the primary heating capacity.

Occupied Standby Mode

To place the controller into the occupied standby mode, a communicated occupancy request is combined with the local (hardwired) occupancy binary input signal. When the communicated occupancy request is unoccupied, the occupancy binary input (if present) does not affect the controller's occupancy. When the communicated occupancy request is occupied, the controller uses the local occupancy binary input to switch between the occupied and occupied standby modes.

Note: *During occupied standby mode, the controller's economizer damper position goes to the economizer standby minimum position. The economizer standby minimum position can be changed using Rover service tool.*

In the occupied standby mode, the controller uses the occupied standby cooling and heating setpoints. Because the occupied standby setpoints typically cover a wider range than the occupied setpoints, the Tracer ZN520 zone controller reduces the control for heating and cooling the space by widening the comfort zone. Also, the outdoor air economizer damper uses the economizer standby minimum position to reduce the ventilation rate.

When no occupancy request is communicated, the occupancy binary input switches the controller’s operating mode between occupied and unoccupied. When no communicated occupancy request exists, the unit cannot switch to occupied standby mode.

Occupied Bypass Mode

The controller can be placed in occupied bypass mode by either communicating an occupancy request of Bypass to the controller or by using the timed override on button on the Trane zone sensor.

When the controller is in unoccupied mode, you can press the On button on the zone sensor to place the controller into occupied bypass mode for the duration of the bypass time (typically, 120 minutes).

Occupancy Sources

The controller's occupancy can be controlled in four ways:

- Communicated request (usually provided by the building automation system or peer device)
- By pressing the zone sensor's timed override On button
- Occupancy binary input
- Default operation of the controller (occupied mode)

A communicated request from a building automation system or another peer controller can change the controller's occupancy. However, if communication is lost, the controller reverts to the default operating mode (occupied) after 15 minutes, if no local hardwired occupancy signal exists.

A communicated request can be provided to control the occupancy of the controller. Typically, the occupancy of the controller is determined by using time-of-day scheduling of the building automation system. The result of the time-of-day schedule can then be communicated to the zone controller.

For complete information about the setup for Tracer Summit applications of this controller, see the Tracer Summit product literature. For more information on the setup of another building automation system, refer to the product-specific literature from that manufacturer.

Determining the Occupancy Mode

The occupancy of the controller is determined by evaluating the combination of three potential communicating inputs, as well as the hardwired occupancy input. Three different communicating inputs affect the controller's occupancy mode:

- Occupancy—manual command
- Occupancy—schedule
- Occupancy—sensor

These inputs provide maximum flexibility, but the number of inputs you decide to use varies with the application and the features available in your building automation system. Table 31, p. 38 describes how these inputs interact to derive the controllers occupancy mode.

Occupancy—manual command

Some communicating devices may request occupancy based on the information communicated in the network variable known as *nvoOccManCmd*. Trane systems and zone sensors do not communicate this information to the controller, but the Tracer ZN520 zone controller accepts this network variable as communicated input *nviOccManCmd*.

Occupancy—schedule

Building automation systems normally communicate an occupancy request using the occupancy—schedule input. The Tracer ZN520 zone controller accepts communicated occupancy schedule as a network variable input known as *nviOccSchedule*.

Occupancy—sensor

Some occupancy sensors may be equipped with the ability to communicate an occupancy mode to the controller. In such devices, a network variable input k known as nviOccSensor is used to communicate occupancy to the controller. Trane systems and zone sensors do not currently send this variable. The hardwired occupancy input of this controller is handled as if it is a communicated occupancy sensor input. When both a hardwired input and a communicated input exist, the communicated input will be used.

Table 31. Effect of occupancy commands on the controller

Occupancy—manual command	Occupancy—schedule	Occupancy—sensor[a]	Controller's effective occupancy
Occupied	Any state	Occupied[b]	Occupied
		Unoccupied	Occupied
Unoccupied	Any state	Any state	Unoccupied
Occupied bypass[c]	Occupied	Any state	Occupied
	Unoccupied	Any state	Occupied bypass
	Occupied standby	Any state	Occupied bypass[c]
	Invalid or not present	Occupied[b]	Occupied
		Unoccupied	Occupied bypass[c]
Occupied standby	Any state	Any state	Occupied standby
Invalid or not present	Occupied	Occupied[b]	Occupied
		Unoccupied	Occupied standby
	Unoccupied	Any state	Unoccupied
	Occupied standby	Any state	Occupied standby
	Invalid or not present	Occupied[b]	Occupied
		Unoccupied	Unoccupied

(a) The occupancy sensor can be either a local input or a communicated input. If a valid value for the network input is present, it has precedence over the local input.
(b) If the occupancy sensor communicated input is invalid or not present, and no local input exists, the controller's mode is occupied.
(c) Occupied bypass is initiated by either a communicated request or a local input. The effective occupancy is occupied bypass.

On and Cancel Buttons on the Zone Sensor

Some Trane zone sensor modules include timed override On and Cancel buttons. Use the timed override On and Cancel buttons to place the controller in override (occupied bypass mode) and to cancel the override request.

The controller always recognizes the timed override On button. If someone presses the zone sensor's timed override On button, the controller initializes the bypass timer to 120 minutes (adjustable).

If the controller is unoccupied when someone presses the On button, the controller immediately changes to occupied bypass mode and remains in the mode until either the timer expires or someone presses the zone sensor's timed override Cancel button. If the On button is pressed during occupied bypass mode, before the timer expires, the controller re-initializes the bypass timer to 120 minutes.

If the controller is in any mode other than unoccupied when someone presses the On button, the controller initializes the bypass time to 120 minutes. As time expires, the bypass timer continues to decrement. During this time, if the controller changes from its current mode to unoccupied (perhaps due to a change based on the system's time of day schedule), the controller switches to occupied bypass mode for the remainder of the bypass time or until someone presses the zone sensor's timed override Cancel button.

Occupancy Binary Input

You can configure binary input 3 (BI 3) as an occupancy binary input. The Tracer ZN520 zone controller uses the occupancy binary input for two occupancy-related functions. For stand-alone controllers (any unit not receiving a communicated occupancy request, typically from a building automation system), the occupancy binary input determines the occupancy of the unit based on the hardwired signal. Normally, the signal is hardwired to a binary switch or clock.

When a hardwired occupancy signal is open, the unit switches to occupied mode (if the occupancy input is configured as normally open). When a hardwired occupancy signal is closed, the controller switches to unoccupied mode.

For controllers that receive a communicated occupancy request from a building automation system, the hardwired occupancy binary input is used with a communicated occupancy request to place the controller in either occupied mode or occupied standby mode.

In occupied mode, the controller operates according to the occupied setpoints. In occupied standby mode, the zone controller operates according to the occupied standby setpoints. When the controller receives a communicated unoccupied request, the controller operates according to the unoccupied setpoints regardless of the hardwired occupancy input state.

If neither the hardwired binary input nor a communicated request is used to select the occupancy mode, the controller defaults to occupied mode because the occupancy binary input (if present) typically is configured as normally open and no occupancy device is connected.

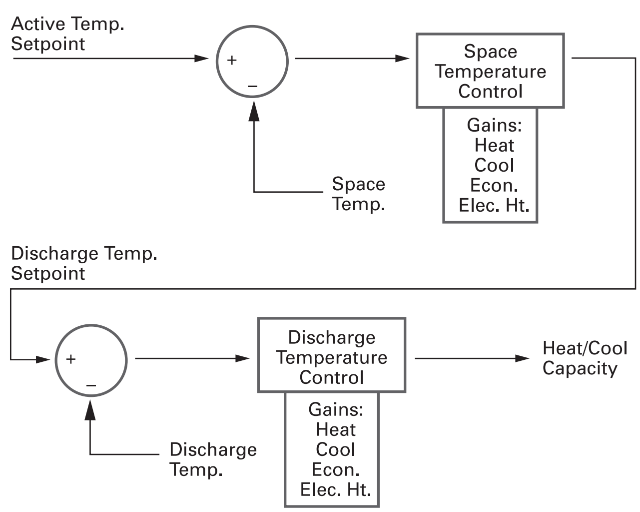
Modulating/Cascade Control

Note: *The Tracer ZN520 does not support discharge temperature control.*

Cascade control differs from zone temperature control in that the unit controls the discharge air temperature to control the zone. Cascade control is thereby able to control the space temperature better than the simpler zone temperature control, which uses only the space temperature and setpoint. The Tracer ZN520 zone controller uses cascade control while occupied, occupied bypass, or in occupied standby and a simplified zone control (described in the previous Unoccupied mode section) when unoccupied.

The cascade control algorithm uses a control error. The control error is the difference between the measured space temperature and the active heating/cooling setpoint (depending on the heat/cool mode). The controller uses the control error in a proportional/integral control algorithm to produce a discharge air temperature setpoint. The control algorithm compares the present discharge air temperature with this setpoint and calculates a unit heat/cool capacity accordingly. The end devices (economizer, valves, etc.) operate based on the unit heat/cool capacity (heat or cool mode, 0 to 100%).

Figure 4. Cascade control block diagram



Heating and cooling operations in the unit are determined by the space temperature error, with the exception of the low discharge air temperature limit. While operating to cool the zone, available heating capacity may be used to maintain discharge air temperature, if the discharge air temperature falls below the minimum discharge setpoint.

Heating or Cooling Control Mode Operation

There are two ways to determine the heating or cooling control mode of the Tracer ZN520 zone controller:

- Communicated request (via *nviHeatCool* or *nviApplicMode*)
- Automatically by the controller

Determining Mode by Communicated Request

A building automation system or peer controller may communicate the heating or cooling mode to the controller via network variables *nviHeatCool* and/or *nviApplicMode*. Heating mode commands the controller to heat only. Cooling mode commands the controller to cool only. The auto mode allows the controller to automatically change from heating to cooling or cooling to heating. See Table 70, p. 74.

Determining Mode Automatically by the Controller

A communicated request of Auto or the controller's default operation (auto) can place the unit into heating or cooling mode. When the controller automatically determines the heating or cooling mode using auto mode, the unit switches to the desired mode based on the control algorithm. When the controller switches to the desired mode, it ramps up the heating and cooling capacity after first determining if heating or cooling is possible.

Example: In heating mode, if the unit is capable of heating, the controller ramps up the heat capacity.

The 2- and 4-pipe hydronic changeover units compare the entering water temperature to the space temperature to determine whether the unit will provide hydronic heating or cooling. To deliver heat, the entering water temperature must be at least five degrees above the space temperature of the unit. To provide cooling, the entering water temperature must be at least five degrees less than the space temperature of the unit.

If the unit has electric heat and electric heat is enabled, the controller is capable of heating even if the entering water temperature is too cool to heat by hydronic means.

Heating and cooling changeover logic

The Tracer ZN520 zone controller can receive communicated requests for heating or cooling operation. The communicated variable *nviApplicMode* is used to communicate the requests for the controller's operating mode based on the following values:

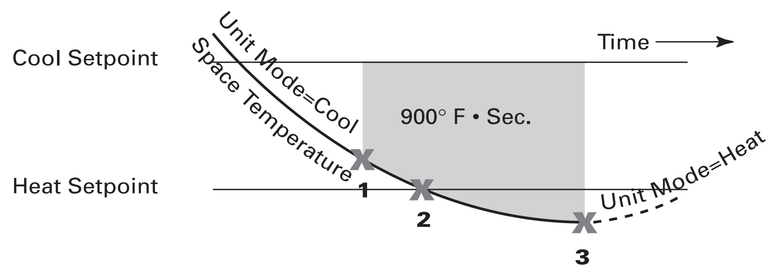
- 0 = Auto (mode determined by controller)
- 1 = Heat (uses heating setpoints)
- 2 = Morning Warm-up
- 3 = Cool (uses cooling setpoints)
- 4 = Night Purge (air changeover)—not supported
- 5 = Pre-cool (morning cool down)
- 6 = Off (no unit operation allowed)
- 7 = Test (special test mode)
- 8 = Emergency Heat—not supported
- 9 = Fan Only (no heating or cooling allowed)

All other enumerations will be interpreted as Auto.

In addition, the controller can receive heat/cool request inputs from communicated *nviHeatCool*. The relationship of *nviApplicMode* and *nviHeatCool* and the result of the controller's heat/cool operating mode is defined in Table 70, p. 74.

As the controller automatically determines its heating or cooling mode, it changes from cool to heat or from heat to cool, when the error (integrated over time) between the active setpoint and the space temperature is (900°F • sec). Integration begins only when the heating and cooling capacity is equal to 0% or the discharge air temperature is being limited by the discharge air temperature control limits. Refer to Figure 5, p. 41.

Figure 5. Heat/cool changeover logic



If the measured space temperature is 69°F and the active cooling setpoint is 72°F, the error between the space temperature and the setpoint is three degrees. If the same error exists for 1 minute (60 seconds), the integration term is (3°F • 60 second) or (180°F • second).

The Tracer ZN520 zone controller changes from heating to cooling and cooling to heating when the integration term exceeds (900°F • second). Along with satisfying the integration for heating and cooling changeover, the measured space temperature must fall outside the setpoint range. This means the space temperature must be greater than the active cooling setpoint or lower than the active heating setpoint.

Example: If the cooling setpoint is 75°F and the heating setpoint 70°F, any space temperature greater than 75°F or less than 70°F is outside the setpoint range.

Once the integration term is satisfied and the space temperature is outside the setpoint range, the controller changes modes. However, before the unit's heating or cooling capacity ramps up, the controller checks to make sure it is capable of heating or cooling.

For some units, heating and cooling capability exists with local resources such as electric heat or compressors. For these units, central heating or cooling plan operation is not required for heating or cooling because they are capable of providing their own local heating or cooling.

For 2-pipe changeover and 4-pipe changeover units with hydronic capacity, heating and cooling is provided through hydronic. For those hydronic, central heating or cooling plant operation is required for the unit to deliver heating or cooling. To determine whether the central plant is providing the desired water temperature, an entering water temperature sensor (either hardwired or communicated) must be present.

The entering water must be five degrees or more above the space temperature to allow hydronic heating, and five degrees or more below the space temperature to allow hydronic cooling.

If the desired water temperature is available, the unit begins normal heating and cooling operation. If the measured entering water temperature is not adequate for the desired heating or cooling, the controller begins the entering water temperature sampling logic.

The Tracer ZN520 zone controller operates the modulating valves and dampers based on a heating or cooling capacity calculated by the control algorithm. The control algorithm calculates the heating or cooling capacity based on the measured space temperature, the active setpoint and the discharge air temperature. When the measured space temperature is within the active heating and cooling setpoints, the heating and cooling capacity approaches zero.

Refer to "DX Operation," p. 51 and "Electric Heat Operation," p. 51 for a more detailed description of operation.

Cooling Operation

Note: *The heating and cooling setpoint high and low limits are always applied to the occupied and occupied standby setpoints.*

During the cooling mode, the Tracer ZN520 zone controller attempts to maintain the space temperature at the active cooling setpoint. Based on the controller's occupancy mode, the active cooling setpoint is one of the following:

- Occupied cooling setpoint
- Occupied standby cooling setpoint
- Unoccupied cooling setpoint

The controller uses the measured space temperature, the active cooling setpoint, and discharge air temperature along with the control algorithm to determine the requested cooling capacity of the unit (0–100%). The outputs are controlled based on the unit configuration and the required cooling capacity. To maintain space temperature control, the Tracer ZN520 zone controller cooling outputs (modulating hydronic valve, 2-position hydronic valve, face/bypass damper, DX, or outdoor air economizer damper) are controlled based on the cooling capacity output.

The cooling output is controlled based on the cooling capacity. At 0% capacity, all cooling capacities are off and the damper is at minimum position. Between 0 and 100% capacity, the cooling outputs are controlled according to modulating valve logic (modulating valves) or cycled on (DX and 2-position valves). As the load increases, modulating outputs open further and binary outputs are energized longer. At 100% capacity, the cooling valve or damper is fully open (modulating valves) or on continuously (DX and 2-position valves).

Face and bypass unit configurations use 2-position, cooling isolation valves to allow water to flow through the coil. The Tracer ZN520 zone controller drives the face and bypass damper to modulate air flow across the water or steam coil. By modulating the volume of air passing through the face to the coil, the unit cooling capacity is modulated. For more information about face and bypass unit operation, see "Face and Bypass Damper Operation," p. 51.

Note: *Diagnostics can affect fan operation, causing occupied and occupied standby fan operation to be defined as abnormal. Refer to Table 61, p. 69 for more information about abnormal fan operation.*

The Tracer ZN520 zone controller operates the supply fan continuously when the controller is in the occupied, occupied bypass, and occupied standby modes, for either heating or cooling. The controller only cycles the fan off with heating and cooling capacity in the unoccupied mode.

The economizer is used for cooling purposes whenever the outdoor temperature is below the economizer enable setpoint and there is a need for cooling. The economizer is used first to meet the space demand, and other forms of cooling are used if the economizer cannot meet the demand alone. See "Modulating Outdoor Air Damper Operation," p. 49 for additional information. A value of Enable or Disable for nviEconEnable overrides other local decisions, regardless of the outdoor temperature.

When economizing is not possible in the occupied mode, the controller opens the outdoor air damper to the occupied minimum damper position or the occupied standby damper position when in the occupied standby mode.

The use of DX and economizer require special handling. See "DX Operation," p. 51 for more information.

Discharge Air Tempering

Cascade cooling control initiates a discharge air tempering function if the discharge air temperature falls below the discharge air temperature control low limit, all cooling capacity is at minimum, and the discharge control loop determines a need to raise the discharge air temperature. The controller then provides heating capacity if available to raise the discharge air temperature to its low limit.

The discharge air tempering function is often invoked when cold outdoor air is brought in through the outdoor air damper, causing the discharge air to fall below the discharge air temperature control low limit. The controller exits the discharge air tempering function when heat capacity has been at 0% for five minutes.

Heating Operation

During the heating mode, the Tracer ZN520 zone controller attempts to maintain the space temperature at the active heating setpoint. Based on the occupancy mode of the controller, the active heating setpoint is one of the following:

- Occupied heating
- Occupied standby heating
- Unoccupied heating

During dehumidification in the heating mode, the controller adjusts the heating setpoint up to the cooling setpoint. This reduces the relative humidity in the space with a minimum of energy usage. If controlling the space to the heating setpoint does not meet the dehumidification requirements the controller will then transition into active dehumidification. For more information on dehumidification, see "Dehumidification," p. 52.

The controller uses the measured space temperature and discharge air temperature, along with the control algorithm, to determine the requested heating capacity of the unit (0–100%). The outputs are controlled based on the unit configuration and the required heating capacity.

Note: *Diagnostics can affect the Tracer ZN520 zone controller operation, causing unit operation to be defined as abnormal. Refer to Table 60, p. 67 for more information about abnormal unit operation.*

The heating output is controlled based on the heating capacity. At 0% capacity, the heating output is off continuously. Between 0 and 100% capacity, the heating output is controlled according to modulating logic or cycled on (2-position valves). As the load increases, modulating outputs open further and binary outputs are energized longer. At 100% capacity, the heating valve is fully open (modulating valves) or on continuously (2-position valves).

Face and bypass unit configurations can use 2-position, heating isolation valves to allow water or steam flow through the coil. The Tracer ZN520 zone controller drives the face and bypass damper to modulate airflow across the hydronic coil. By modulating the volume of air passing through the face of the coil, the unit heating capacity is modulated. For more information about face and bypass unit operation, see "Face and Bypass Damper Operation," p. 51.

The Tracer ZN520 zone controller fan output(s) normally run continuously during the occupied, occupied bypass, and occupied standby modes, but cycle between high and off speeds with heating/cooling during the unoccupied mode. When in the occupied mode, occupied bypass, or occupied standby mode and the unit supply fan is set to high, medium, or low (when present), the fan runs continuously at the selected speed. Refer to Table 61, p. 69 for more information on abnormal fan operation.

When the unit's supply fan is set to auto, the controller's configuration determines the fan speed when in the occupied mode, occupied bypass, or occupied standby mode. The fan runs continuously at the configured heating fan speed or cooling fan speed. For all fan speed selections except off, the fan cycles off during unoccupied mode.

The economizer outdoor air damper is never used as a source of heating. Instead, the economizer damper (when present) is only used for ventilation during the heating mode; therefore, the damper is at the occupied minimum position in the occupied mode. For more information about damper operation, see "Modulating Outdoor Air Damper Operation," p. 49.

Coil Changeover

Coil changeover refers to using the main hydronic coil for both heating and cooling. Coil changeover is only used in a hydronic system designed to use the main water coil (Valve/Coil 1) for both heating and cooling. If the coil is configured for main coil changeover, the controller requires a valid entering water temperature to ensure reliable heating/cooling control decisions. The entering water temperature may be communicated or may be hardwired to analog input 1 of the controller (AI 1). If the unit is not applied as a coil changeover unit, the controller uses the entering water temperature (when present) for information only.

If the entering water temperature is expected and the valid value does not exist, the controller allows only hydronic heating operation (hydronic cooling capacity always equals 0%, DX and economizing are allowed). In the heating mode, the controller is only permitted to heat (when required) and cannot cool.

Entering Water Temperature Sampling Function

The Tracer ZN520 zone controller can sample the entering water temperature for all hydronic main coil changeover units. The entering water temperature value is important for reliable heating and cooling control. The entering water temperature must be five degrees above the space temperature for hydronic heating and five degrees below the space temperature for hydronic cooling.

Note: *The controller invokes entering water temperature sampling only when the measured entering water temperature is too cool to heat or too warm to cool. Entering water is cold enough to cool when it is five degrees below the measured space temperature. Entering water is warm enough to heat when it is five degrees above the measured space temperature.*

When water flows normally and frequently through the coil, the controller does not invoke the sampling function because the water temperature is satisfactory for the desired heating or cooling. During changeover, the zone controller determines its ability to deliver heating or cooling. The controller invokes entering water temperature sampling if the entering water temperature is not adequate for delivering the desired heating or cooling.

Only units using the main hydronic coil for both heating and cooling (2-pipe changeover and 4-pipe changeover units) use the entering water temperature sampling function. For all applications other than 2-pipe changeover and 4-pipe changeover, the entering water temperature does not affect unit operation, but can be used for information.

Using three-way control valves, the central water loop continuously flows, either through the coil or bypassed around the coil. Because the water is continuously flowing, the entering water temperature sensor can be installed on the pipe where to flow is constant. For both three-way valves and bleed lines, continuous waterflow, combined with proper sensor location, gives a reliable measurement of the entering water temperature.

Note: *The Tracer ZN520 zone controller offers a control solution for two-way valve applications that does not require special unit consideration, such as those required by bleed lines. The controller includes an entering water temperature sampling function that periodically opens the two-way valve to allow temporary waterflow, producing reliable entering water temperature measurement.*

When the controller invokes the entering water temperature sampling function, the unit opens the main hydronic valve for no more than three minutes while measuring entering water temperature. An initial stabilization period is allowed to flush the coil, a period of time is equal to 30 seconds plus 1/2 the valve stroke time. Once this temperature stabilization period has expired, the controller compares the entering water temperature against the effective space temperature (either hardwired or communicated) to determine whether the entering water can be used for the desired heating or cooling. If the water temperature is not usable for the desired mode, the controller continues to compare the entering water temperature against the effective space temperature for a maximum of three minutes.

When the entering water temperature is warmer than 110°F, the controller assumes the entering water temperature is hot because it is unlikely the coil would drift to a high temperature unless the actual loop temperature was very high.

If the entering water temperature is not usable for the required capacity controller closes the hydronic valve and waits 60 minutes before initializing another sampling. If the controller determines the entering water temperature is valid for heating or cooling, it resumes normal heating/cooling control and effectively disables entering water temperature sampling until it is required.

Fan Operation

For multiple fan speed applications, the Tracer ZN520 zone controller offers additional fan configuration flexibility. Separate default fan speeds for heating and cooling modes can be configured. The fan runs continuously for requested speeds (high, medium, or low). When the fan mode switch is in the Auto position or a hardwired fan mode input does not exist, the fan operates at the default configured speed.

If the fan mode is auto and the default fan speed is auto, then the fan may switch speeds, depending on the error. If the cool default is auto, as capacity needed, the fan speed increases as space temperature increases above the active cooling setpoint. If the heat default is auto, need for heating capacity needed, the fan speed increases as space temperature changes below the active heating setpoint.

See Table 32 for default fan configuration for heat and cool mode. During unoccupied mode, the fan cycles between high speed and off with heating and cooling fan modes. If the requested speed is off, the fan always remains off.

Table 32. Fan configuration

	Auto fan operation	Fan speed default
Heating	Continuous	Off Low Medium High Auto
Cooling	Continuous	Off Low Medium High Auto

Additional flexibility built into the controller allows you to enable or disable the local fan switch input. The fan mode request can be either hardwired or communicated to the controller. When both are present, the communicated request has priority over the hardwired input. Refer to Table 33 and Table 34.

Table 33. Local fan switch disabled or not present

Communicated fan speed input	Fan operation
Off	Off
Low	Low
Medium	Medium
High	High
Auto (or not present)	Auto (fan runs at the default speed)

Table 34. Local fan switch enabled

Communicated fan speed input	Fan switch (local)	Fan operation
Off	Ignored	Off
Low	Ignored	Low
Medium	Ignored	Medium
High	Ignored	High
Auto	Off Low Medium High Auto	Off Low Medium High Auto (configured default, determined by heat/cool mode)

Continuous Fan Operation

During occupied and occupied standby modes, the fan normally is on. For multiple speed fan applications, the fan normally operates at the selected or default speed (off, high, medium, low, auto). When fan mode is auto, the fan operates at the default fan speed. See Table 35, p. 46 for fan operation during heating and cooling operation for all occupancy modes.

Table 35. Fan operation in heating and cooling modes

Fan mode	While heating		While cooling	
	Occupied/ Occupied standby/ Occupied bypass	Unoccupied	Occupied/ Occupied standby/ Occupied bBypass	Unoccupied
Off	Off	Off	Off	Off
Low	Low	Off/High	Low	Off/High
Medium	Medium	Off/High	Medium	Off/High
High	High	Off/High	High	Off/High
Auto (continuous)	Heat default fan speed	Off/High	Cool default fan speed	Off/High

The fan is off when:

- The unit is off due to a diagnostic
- The unit is off due to the local zone sensor
- A request for the unit to be off has been communicated
- The fan is in auto mode, but the default speed is off

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

Cycling Fan Operation

The fan cycles between high speed and off in the unoccupied mode only. The controller's cascade control algorithm requires continuous fan operation in the occupied, occupied bypass, and occupied standby modes. Tracer ZN520 zone controller **does not support** fan cycling in occupied mode.

During unoccupied mode, the controller controls the fan off. While unoccupied, the controller heats and cools to maintain the unoccupied heating and cooling setpoints. In unoccupied mode, the fan is controlled at high speed only with heating or cooling.

Fan Off Delay

When a heating output is controlled off, the Tracer ZN520 zone controller automatically holds the fan on for an additional 30 seconds. This 30-second delay gives the fan time to blow off any residual heat from the heating source, such as a steam coil. When the unit is heating, the fan off delay is normally applied to control the fan; otherwise, the fan off delay does not apply.

Fan Start on High Speed

On a transition from off to any other fan speed, the Tracer ZN520 zone controller automatically starts the fan on high speed and runs the fan at high speed for 0.5 seconds for fan coils and for 3.0 seconds for unit ventilators and blower coils. This provides the ample torque required to start all fan motors from the off position.

Exhaust Fan/Damper Operation

Note: *Exhaust fan is turned off/on based on the target position of the economizing damper.*

This binary point is a shared point with medium fan speed. For exhaust control, configure the controller for a 1-or 2-speed fan. The exhaust fan/damper is coordinated with the unit fan and outdoor damper operation. The exhaust output is energized only when the unit fan is operating and the outdoor damper position is greater than or equal to the configurable exhaust enable point. The exhaust fan output is disabled when the outdoor air damper position drops 10% below the exhaust enable point. If the enable point is less than 10%, the unit turns on at the enable point and off at 0.

Valve Operation

Modulating Valve Operation

The Tracer ZN520 zone controller supports one or two modulating valves for hydronic heating and cooling operation. The main valve/coil is used for heating only, cooling only, or heat/cool changeover. The auxiliary valve/coil only provides heating for the following applications:

- 4-pipe heat/cool
- 4-pipe heat/cool changeover

The auxiliary valve/coil is capable of providing only heating (4-pipe operation). Typical 2-pipe changeover configurations allow for both cooling (summer mode) and heating (winter mode) with the main valve/coil.

Four-pipe configurations normally utilize the main valve/coil as the cooling source and the auxiliary valve/coil as the heating source. The controller also supports main coil changeover for 4-pipe configurations.

Modulating Valve Calibration

Calibrating modulating valves is a part of the controller's normal operation, whether at power-up or during heating and cooling. At power-up, the Tracer ZN520 zone controller drives modulating valves and dampers to the closed position. The controller calibrates to the full closed position by overdriving the actuator (135% of drive time).

Note: *Whenever the Tracer ZN520 zone controller generates a valve position request of zero or 100%, the unit calibrates modulating valves by overdriving the valves.*

The controller moves the modulating valve to the desired positions based on calculated capacity. Whenever the controller requests a valve position of either zero or 100%, the controller overdrives the output by 135% of the stroke time, regardless of the current valve position.

2-position Valve Operation

Tracer ZN520 zone controller supports 2-position valves for hydronic heating and cooling operation. The main valve/coil is used for heating only, cooling only, or heat/cool changeover. The auxiliary valve/coil provides only heating for the following applications:

- 4-pipe heat/cool
- 4-pipe heat/cool changeover

The auxiliary valve/coil is capable of providing only heating (4-pipe operation). Typical 2-pipe changeover configurations allow for both cooling (summer mode) and heating (winter mode) with the main valve/coil.

Four-pipe configurations normally utilize the main valve/coil as the cooling source and the auxiliary valve/coil as the heating source. The controller also supports main coil changeover for 4-pipe configurations.

To control the space temperature, 2-position valves are cycled to control the discharge air temperature. The rate of cycling is dependent upon entering water temperature, the load in the space, and the temperature of the incoming fresh air from the economizer (if any).

Face and Bypass Isolation Valve Operation

Face and bypass units may use isolation valves to prevent unwanted water flow in the coil when no air flow is present through the coil (bypass). In 2-pipe applications, the isolation valve stops water flow, preventing radiant heat and excessive condensate from the coil.

In 4-pipe applications, the isolation valves are used to prevent conflicting capacities (hot and chilled water) from entering the coil at the same time. Only one isolation valve allows water flow at a time during normal operation.

Two-pipe Operation

When the 2-pipe changeover unit is configured with electric heat, the controller uses the electric heat if the entering water temperature is not appropriate for hydronic heating.

Two-pipe heating-only units and all units with a heat control request (provided by a communicated heat/cool request) are capable of providing only heating. Two-pipe cooling-only units and all units with a cool control request (provided by a communicated heat/cool request) are capable of providing only cooling.

Two-pipe changeover units capable of both hydronic heating and hydronic cooling determine their mode based on the following sequence (summarized in Table 36, p. 48):

1. If the controlled space requires heating or cooling, the controller changes from heating to cooling and cooling to heating based on the space temperature, active setpoint, and the integrated error between the two. Once the controller changes modes, it verifies the entering water temperature.
2. When the entering water temperature is not appropriate for the desired capacity (either heating or cooling), the controller remains at 0% capacity for hydronic capacity.
3. When the entering water temperature is appropriate to deliver the desired heating or cooling, the controller resumes normal operation. If the controller does not have a valid entering water temperature, the controller assumes hot water is always present in the main coil.
4. If the entering water temperature is appropriate for heating or cooling, the controller energizes the appropriate output to control the space temperature at the heating setpoint or dehumidifying setpoint in heat mode, or at the cooling setpoint in cool mode.

Table 36. 2-pipe main coil operation

Unit	Entering water temperature	Main coil	Operation
2-pipe heating only	NA	Hot	Main coil heating
2-pipe cooling only	NA	Cold	Main coil cooling
2-pipe changeover	Cold	Cold	Main coil cooling
	Hot	Hot	Main coil heating

For more information about 2-pipe operation, see "Coil Changeover," p. 43.

Four-pipe Operation

Four-pipe units normally assume there is chilled water in the primary coil and hot water in the secondary coil. The controller energizes the cooling valve output (valve 1) to control the space temperature at the cooling setpoint in cool mode. The controller energizes the heating valve output (valve 2) to control the space temperature at the heating setpoint in heat mode. During normal unit operation, the controller never opens both the heating valve and the cooling valve at once.

The controller also supports 4-pipe main coil changeover—using the main hydronic coil for both heating and cooling. For all 4-pipe units, the auxiliary coil is always assumed hot by the controller. During normal unit operation, the controller never uses the main coil and auxiliary coil simultaneously.

Four-pipe changeover units capable of both hydronic heating and hydronic cooling with the main coil determine their mode based on the following sequence (summarized in Table 37, p. 49):

1. If the controlled space requires heating or cooling, the controller changes from heating to cooling and cooling to heating based on the space temperature, active setpoint and the integrated error between the two. Once the controller changes modes, it verifies the entering water temperature.

Note: *If the controller does not have available the entering water temperature, either communicated or hardwired on a changeover coil, the controller restricts the hydronic cooling capacity to 0% and only allows heating.*

2. When the main/primary coil entering water temperature is not appropriate for cooling, the controller can change to cooling mode, but remains at 0% capacity for hydronic capacity. When the main/primary coil entering water temperature is not appropriate for heating, the controller can change to heating mode and use the auxiliary coil for heating.
3. When the entering water temperature is appropriate to deliver the desired heating or cooling, the controller selects the primary coil to deliver heating or cooling and resumes normal operation.

Table 37. 4-pipe main and auxiliary coil operation

Unit	Entering water temperature	Main coil	Auxiliary coil	Operation
4-pipe	Not present	Cold	Assumed hot[a]	Main coil cooling, Auxiliary coil heating
4-pipe changeover	Cold	Cold	Assumed hot[a]	Main coil cooling, Auxiliary coil heating
	Hot	Hot	Assumed hot[a]	Main coil heating, Auxiliary coil not used

(a) The entering water temperature sensor is normally applied to changeover units on the main coil. Since the controller cannot determine the auxiliary coil water temperature, the auxiliary coil is assumed hot.

For more information about 4-pipe operation, see "Coil Changeover," p. 43.

Two-position Damper Operation

The Tracer ZN520 zone controller does not support 2-position outdoor air damper.

A form of 2-position control can be accomplished using a modulating outdoor air damper actuator and the damper minimum position value. This is accomplished by not providing an outdoor air temperature, either hardwired or communicated, to the controller, and using the Roverservice tool to set the damper minimum position to the desired value.

Modulating Outdoor Air Damper Operation

The controller operates the modulating (3-wire floating) outdoor air damper according to the effective occupancy, outdoor air temperature (communicated or hardwired sensor), space temperature, effective setpoint, discharge air temperature, and discharge air temperature setpoint. Default minimum damper positions are provided and can be changed (using Trane's Rover service tool) for occupied and occupied standby modes, and for low=speed fan operation. The controller can also receive a communicated outdoor air minimum position from Tracer Summit. See Table 38, p. 49 and Table 39, p. 50.

A communicated minimum position from Tracer Summit has priority over all configured setpoints. When a communicated minimum position is not present, the controller uses the configured minimum for low fan speed whenever the fan is running at low speed, regardless of the occupancy state.

Table 38. Determining the economizer damper minimum position setpoint

Occupancy	Tracer Summit setpoint	Fan speed	Active minimum setpoint
Unoccupied	Any value	Any value	0%
Occupied Occupied bypass Occupied standby	Valid	Any value	Tracer Summit
Occupied Occupied bypass Occupied standby	Invalid	Low	Occupied low fan minimum
Occupied Occupied bypass	Invalid	Med/high	Occupied minimum
Occupied standby	Invalid	Med/high	Occupied standby minimum

During occupied modes, the damper remains at a minimum damper position, whether a configured minimum position or communicated from Tracer Summit, unless ASHRAE Cycle 1, ASHRAE Cycle 2, or economizer functions are active.

ASHRAE Cycle 1 Conformance

ASHRAE cycle 1 admits 100% outdoor air at all times except during a warm-up cycle. To set up the Tracer ZN520 zone controller for ASHRAE cycle 1 conformance, set the occupied outdoor air damper minimum position to 100% open. During occupied periods, the modulating damper opens 100%.

If the space temperature drops 3ºF below the active setpoint, the Tracer ZN520 zone controller closes the outdoor air damper regardless of the active minimum damper position.

ASHRAE Cycle 2 Conformance

Note: *If the zone temperature drops 3ºF below the active setpoint, the Tracer ZN520 zone controller closes the outdoor air damper regardless of the active minimum damper position.*

The Tracer ZN520 zone controller conforms to the ASHRAE cycle 2 by allowing the modulating outdoor damper to completely close when the space temperature drops 3°F or more below the effective setpoint. When the space temperature rises within 2°F of the effective setpoint, the damper is allowed to open to the occupied or occupied standby minimum damper positions. When the space temperature is between 2ºF and 3ºF below the setpoint, the damper is set between 0 and the minimum damper position.

If the discharge air temperature is between the discharge air temperature low limit and the discharge air temperature low setpoint, the damper modulates between closed and the minimum position. When this function and ASHRAE cycle 2 are both active, the minimum of the two control points is chosen.

The ASHRAE cycle 2 operation is only available on units equipped with a modulating outdoor air damper.

Economizer Operation

With a valid outdoor air temperature (either hardwired or communicated), Tracer ZN520 zone controller uses the modulating economizer damper as the highest priority source of cooling. Outdoor air is used as a source of cooling capacity before hydronic cooling; this function is known as economizing. Economizer operation is only possible through the use of a modulating damper.

The controller initiates the economizer function if the outdoor air temperature is cold enough to be used as free cooling capacity. If the outdoor air temperature is less than the economizer enable setpoint (absolute dry bulb), the controller modulates the outdoor air damper (between the active minimum damper position and 100%) to control the amount of outdoor air cooling capacity. When the outdoor air temperature rises 5°F above the economizer enable point, the controller disables economizing and moves the outdoor air damper back to its predetermined minimum position based on the current occupancy mode or communicated minimum damper position.

Note: *Economizing is possible during the occupied, occupied standby, unoccupied, and occupied bypass modes.*

Table 39. Relationship between outdoor temperature sensors and damper position

Outdoor air temperature	Modulating outdoor air damper position[(a)]		
	Occupied or Occupied bypass	Occupied standby	Unoccupied
No or invalid outdoor air temperature:	Open to occupied minimum position	Open to occupied standby minimum position	Closed
Failed outdoor air sensor:	Open to occupied minimum position	Open to occupied standby minimum position	Closed
Outdoor air temperature present and economizing feasible:	Economizing, damper controlled between occupied minimum position and 100%	Economizing, damper controlled between occupied standby minimum position and 100%	Open and economizing during unit operation, otherwise closed
Outdoor air temperature present and economizing not feasible:	Open to occupied minimum position	Open to occupied standby minimum position	Closed

(a) An value of Enable or Disable for nviEconEnable overrides the local decision about damper position, regardless of the presence of an outdoor air temperature value.

Modulating Outdoor Air Damper Calibration

Similar to the modulating valve calibration, the modulating outdoor air damper calibration is a part of the controller's normal operation, whether at power-up or during heating and cooling. At power-up, the Tracer ZN520 zone controller drives the modulating outdoor air damper to the closed position. The controller calibrates to the fully closed position by overdriving the actuator (135% of drive time).

Note: *Whenever the Tracer ZN520 zone controller generates a damper position request of zero or 100%, the unit calibrates the damper actuator by overdriving it.*

The controller moves the modulating damper to desired positions based on calculated capacity. Whenever the controller requests a damper position of either zero or 100%, the controller overdrives the output by 135% of the stroke time regardless of the current damper position.

Face and Bypass Damper Operation

The Tracer ZN520 zone controller actuates face and bypass damper to modulate a percentage of air to the face of the coil and around the coil (bypass) to maintain space comfort. Isolation valves (if present) are used to control water flow through the unit during heating and cooling operation.

In 2-pipe changeover applications, the water temperature needs to suit the required mode. If the controller requests heating and hot water is available, the face and bypass damper modulate to the face position. If the controller requests heating and hot water is not available, the face and bypass damper remains in the bypass position and water sampling may be invoked. See “Entering Water Temperature Sampling Function,” p. 44.

In 4-pipe applications it is assumed that both heat and cool capacity are available. See “Valve Operation,” p. 47“ for more information on isolation valve operation.

Upon power-up, the controller calibrates the face and bypass damper to the full bypass position by overdriving the damper 135% of the stroke time. During normal operation, whenever the Tracer ZN520 zone controller generates a face and bypass damper position request of zero or 100%, the unit calibrates the actuator by overdriving the damper 135% of the stroke time.

DX Operation

Tracer ZN520 zone controller supports direct expansion (DX) compressor operation for cooling only.

The controller does not use both the DX compressor and the economizer at the same time. This prevents problems where the entering air temperature is too low for the evaporator coil to operate as designed, leading to short cycling of the compressor due to low discharge air temperatures.

Electric Heat Operation

The Tracer ZN520 zone controller supports 1- or 2-stage electric heat operation for heating.

To control the space temperature, electric heat is cycled to control the discharge air temperature. The rate of cycling is dependent upon the load in the space and the temperature of the incoming fresh air from the economizer (if any).

Two-pipe changeover units with electric heat use the electric heat only when hot water is not available. The use of hot water AND electric heat is not supported. See “Coil Changeover,” p. 43 for further explanation.

Output Overrides

The controller can override the binary outputs, typically for test and commissioning, using Trane's Tracer Summit building automation system or from Rover service tool. For more information on the output overrides, refer to the product-specific literature for the building automation system and the service tool.

Manual Output Test

Manual output test allows the user to manually exercise the outputs in a predefined sequence. For more information, refer to “Manual Output Test,” p. 51.

Water Valve Override

For supporting water balancing, the controller includes a communication variable (nviValveOverride) that allows a user to specify the desired state of all water valves. The only values supported are:

- Open all valves
- Close all valves

To maintain the controller in valve override, this variable must be rewritten at least once every two hours. The controller resets itself if the variable is not refreshed within two hours or any other value except open or closed is written to it.

Rover or another communicating device is required to access this feature.

Fan Status

The status of the fan is reported based on the state of the binary output(s) dedicated to fan control. The fan status is reported as High, Medium, or Low whenever the corresponding binary output is directed on. In all configurations, the fan status is reported as Off when none of the fan outputs is energized.

The Tracer ZN520 zone controller can be connected to a fan status switch (when present on binary input 4) that provides a diagnostic for belt-drive units or direct-drive units as needed. The fan status switch provides feedback to the controller that the fan is in operation when the fan binary outputs are energized.

If the controller energizes a fan output for one full minute and the fan status switch indicates no fan operation, the controller performs a unit shutdown and generates a Low AirFlow—Fan Failure diagnostic. The controller also generates a Low AirFlow—Fan Failure diagnostic if the fan status switch indicates no fan operation for one minute after the fan has been operating normally. The fan condition and the diagnostic must be cleared before the unit is allowed to operate. If a diagnostic reset is sent to the controller and the fan condition still exists, the controller attempts to run the fan for one minute before generating another diagnostic and performing a unit shutdown.

Binary input 4 (BI4) is in the closed position when the fan is in operation and is in the open position when fan operation has stopped.

Filter Status

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 (maintenance required setpoint time, stored in the controller) and recommends unit maintenance as required.

Use Rover service tool to edit the maintenance required setpoint time. Once the setpoint limit is exceeded, the controller generates a Maintenance Required informational diagnostic. When the maintenance required setpoint time is set to zero, the controller disables the diagnostic feature.

You can use Rover service tool to clear the Maintenance Required informational diagnostic. Once the diagnostic is cleared, the controller resets the fan run time to zero and begins accumulating fan run hours again.

Data Sharing

Because this controller utilizes LonWorks® technology, the controller can send or receive data (setpoint, heat/cool mode, fan request, space temperature, etc.) to and from other controllers on the communication link, with or without the existence of a building automation system. This applies to applications where multiple zone controllers share a single space temperature sensor (for rooms with multiple units but only one zone sensor) for both stand-alone (with communication wiring between units) and building automation system applications.

Additional information on the setup and application of this feature can be found in "Stand-Alone Peer-to-Peer," p. 61.

Other Modes

Dehumidification

Dehumidification is possible when mechanical cooling is available, the heating capacity is located in the reheat position, and the space relative humidity setpoint is valid. The controller starts dehumidifying the space when the space humidity exceeds the humidity setpoint. The controller continues to dehumidify until the sensed humidity falls below the setpoint minus the relative humidity offset. This sequence is not available for face and bypass units.

The controller uses the cooling and reheat capacities simultaneously to dehumidify the space. While dehumidifying, the discharge air temperature is controlled to maintain the space temperature at the current setpoint.

A typical scenario involves high humidity and high temperature load of the space. The controller sets the cooling capacity to 100% and uses the reheat capacity to warm the discharge air to maintain space temperature control.

Note: *If the unit is in the unoccupied mode, the dehumidification routine will not operate.*

Economizing is disabled during dehumidification. Dehumidification may be disabled via configuration.

Freeze Avoidance

Freeze avoidance is used as low ambient temperature protection and is only invoked when the fan is off. This includes unoccupied mode when there is no call for capacity or any other time the fan is off. The controller enters the freeze avoidance mode when the outdoor air temperature is below the freeze avoidance setpoint (configurable). The controller disables freeze avoidance when the outdoor air temperature rises 3°F above the freeze avoidance setpoint.

When the controller is in freeze avoidance mode:

- All water valves are driven open to allow water to flow through the coil
- Fan is off
- Face bypass damper (when present) is at full bypass
- DX and electric heat are off

For additional coil protection, the Tracer ZN520 zone controller disables economizing and drives the outdoor air damper closed during freeze avoidance mode.

Freeze Protection (Discharge Air Temperature Low Limit)

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 three minutes, the controller generates a Discharge Air Temp Limit diagnostic.

When the controller has generated a Discharge Air Temp Limit diagnostic:

- All water valves are driven open to allow water to flow through the coil
- Fan is off
- Face bypass damper (when present) is at full bypass
- DX compressor (when present) is off
- Electric heat (when present) is off

For additional coil protection, the Tracer ZN520 zone controller disables economizing and drives the outdoor air damper closed during a freeze protection diagnostic.

Night Setback Operation

The controller always operates in one of these occupancy modes:

- Occupied
- Occupied standby
- Occupied bypass
- Unoccupied

Occupied operation normally is used during the daytime hours when people occupy the space. In occupied mode, the controller uses occupied heating and cooling setpoints.

Occupied standby operation is desired during daytime hours when people are not present in the space. An occupancy sensor or some other device is used to determine if the space is unoccupied. In occupied standby mode, the controller uses occupied standby heating and cooling setpoints as well as the occupied standby damper position. The occupied standby setpoints are usually wider than the occupied setpoints.

Example: The occupied standby cooling setpoint is normally higher than the occupied cooling setpoint and the occupied standby heating setpoint is normally lower than the occupied heating setpoint.

Occupied bypass operation is associated with timed override (from unoccupied mode). In occupied bypass mode, the controller uses all the occupied setpoints, but reports occupied bypass as the active mode to represent the override mode.

Unoccupied operation is normally associated with evening hours when the space is vacant. In the unoccupied mode, the controller always uses the default unoccupied heating and cooling setpoints, which are stored in the controller.

When the controller sets the space to unoccupied, the occupant may have the ability to request timed override. Based on the controller or system setup, the controller interprets the request and initiates the occupied setpoint operation. During a timed override, the controller applies all occupied setpoints, but reports the effective occupancy mode as occupied bypass.

Morning Warm-up

The controller keeps the economizer and the modulating outdoor air damper closed (when configured for modulating outdoor air damper control and an outdoor air damper is present) anytime during the occupied mode when the space temperature is three degrees or more below the heating setpoint.

The damper remains closed indefinitely (no time limit) during morning warmup until the space temperature is greater than 3ºF below the effective heating setpoint. The damper modulates between closed and minimum position when the space temperature is 2–3ºF below the effective heating setpoint.

The modulating outdoor air damper normally is open to a minimum position during the occupied mode when the controller turns on the unit fan. The damper normally is closed during:

- Occupied mode when the fan is off
- Warm-up/cool-down mode
- Unoccupied mode
- Freeze avoidance
- Certain diagnostic conditions

This conforms to ASHRAE Cycle 2.

Cool-Stand-Alonedown

The controller keeps the modulating outdoor air damper closed (when the controller is configured for modulating outdoor air damper control and an outdoor air damper is present) for up to one hour at every transition from unoccupied to occupied mode when the space temperature is three degrees or more above the cooling setpoint.

The damper remains closed during cool-down until the space temperature is within three degrees of the effective cooling setpoint. The damper normally is closed during:

- Occupied mode when the fan is off
- Warm-up/cool-down mode
- Unoccupied mode
- Freeze avoidance
- Certain diagnostic conditions

This conforms to ASHRAE cycle 2.

The damper modulates between closed and minimum position when the space temperature is 2–3ºF above the effective cooling setpoint.

TRANE

Configuration

Note: *The Tracer ZN520 zone controller only supports cascade control by controlling the discharge air temperature. Therefore, the controller requires both a space temperature input and a discharge air temperature input.*

Trane configures the Tracer ZN520 zone controller at the factory per unit configuration. The controller is applied to fan coil, unit ventilator, and blower coil configurations that support modulating valves, 2-position valves, economizer damper (modulating only), direct expansion (DX) cooling, 1- and 2 -stage electric, face and bypass damper, baseboard heat, dehumidification, and generic binary output. The controller also supports 1-, 2-, and 3-speed fans with exhaust fan output on 1- and 2-speed fan applications (medium fan speed output). See Table 40 for actuator types supported for different configurations.

Table 40. Typical applications supported

Configuration	Type of valve		Options		
	Modulating	2 position	Electric heat (1 or 2 stage)	Economizer damper	Baseboard heat
2-pipe cooling only	✓	✓	✓	✓	
2-pipe heating only	✓	✓		✓	✓
2-pipe changeover	✓	✓	✓	✓	✓
4-pipe	✓	✓		✓	✓
4-pipe changeover	✓	✓		✓	✓
2-pipe face bypass heating only		✓ (a)		✓	✓
2-pipe face bypass changeover		✓ (a)		✓	✓
4-pipe face bypass		✓ (a)		✓	✓
DX cooling only	NA	NA		✓	
DX cooling, 2-pipe heating	✓	✓		✓	✓
DX cooling, electric heating	NA	NA	✓	✓	✓
Electric heat only (1 or 2 stage)	NA	NA	✓	✓	✓

(a) Isolation valves are 2-position only.

Rover Service Tool

With the Rover service tool, you can calibrate two of the controller's analog inputs: space temperature and setpoint. For each input, the calibration value is added to the measured value to determine the effective value.

- Space temperature (±10.0ºF, 0.1ºF resolution)
- Local setpoint (±10.0ºF, 0.1ºF resolution)

Configurable Parameters

Unit Type

- Fan coil
- Blower coil
- Unit ventilator

Rover service tool uses the unit type (fan coil, blower coil, or unit ventilator) to determine and download many other aspects of the unit configuration, such as the default analog input configuration, the default binary input configuration, and the default binary output configuration. See Table 43, p. 57 to Table 54, p. 60.

Cooling Source

- None

- Hydronic (main coil changeover)
- Dedicated hydronic
- DX

Heating Source

- None
- Hydronic
- Dedicated hydronic
- Steam
- Electric heat
- Hydronic (main coil changeover) + dedicated hydronic (auxiliary coil)
- Hydronic (main coil changeover)

Table 41. Coil temperature definition

Cooling source	Heating source	Main coil	Auxiliary coil	Description
None	None			
	Hydronic (changeover)			
	Hydronic, dedicated coil heating	Hot	NA	2-pipe heat only
	Steam	Hot	NA	2-pipe steam heat only
	Compressor			
	Electric	NA	NA	Electric heat only (Force Flo)
	Hydronic (changeover)+ dedicated hydronic			
	Hydronic (changeover)+ electric			
Hydronic, main coil changeover	None			
	Hydronic, main coil changeover	(a)	NA	2-pipe changeover
	Dedicated hydronic			
	Steam			
	Compressor			
	Electric			
	Hydronic coil changeover + auxiliary coil heating	(a)	Hot	4-pipe changeover
	Hydronic (changeover)+ electric	(a)	NA	2-pipe changeover w/ electric heat
Hydronic, main coil cooling	None	Cold	NA	2-pipe cooling only
	Hydronic (changeover)			
	Hydronic, dedicated coil heating	Cold	Hot	4-pipe
	Steam	Cold	Hot	4-pipe (steam heat)
	Compressor			
	Electric	Cold	NA	2-pipe coolonly w/ electric heat
	Hydronic (changeover)+ dedicated hydronic			
	Hydronic (changeover)+ electric			

Table 41. Coil temperature definition (continued)

Cooling source	Heating source	Main coil	Auxiliary coil	Description
DX	None	Cold	NA	
	Hydronic (changeover)			
	Dedicated Hydronic	NA	Hot	DX unit vent w/ hot water heat
	Steam	NA	Hot	DX unit vent w/ hot water heat
	Compressor			
	Electric	NA	NA	DX unit vent w/ electric heat
	Hydronic (changeover)+ dedicated hydronic			
	Hydronic (changeover)+ electric			

(a) Table 42, p. 57 identifies the logic for determining the main coil temperature for main coil changeover applications.

Table 42. Determining the main coil temperature for main coil changeover applications

Local entering water temperature present	Communicated entering water temperature present	Result
No	No	• Unit is only permitted to only deliver heat. • Water assumed hot. • Control algorithm cooling capacity remains at 0%.
No	Yes	• The controller always uses the communicated water temperature to determine whether the unit can heat or cool as required. • Entering water temperature sampling not allowed.
Yes	No	• The controller always uses the local hardwired entering water temperature to determine whether the unit can heat or cool as required. • Entering water temperature sampling (if enabled) is invoked as required.
Yes	Yes	• The controller always uses the communicated water temperature instead of the local value, to determine whether the unit can heat or cool as required. • Entering water temperature sampling not allowed.

Table 43. Binary outputs

Binary output	Fan coil	Blower coil	Unit vent	Valid range
J1-1	Fan high	Fan high	Fan high	NA
J1-2	Fan medium	Exhaust fan or none	Exhaust fan or none	NA
J1-3	Fan low	Fan low	Fan low	NA
J1-4	(Key)	(Key)	(Key)	NA
J1-5	Cooling valve open	Cooling valve open	Cooling valve open	NA
			Face bypass cool isolation valve	Normally open or normally closed
	2-position cooling	2-position cooling	2-position cooling	Normally open or normally closed
			DX	NA
J1-6	Cooling valve close	Cooling valve close	Cooling valve close	NA
J1-7	NA	NA	Face bypass damper open	NA
J1-8	NA	NA	Face bypass damper close	NA
J1-9	Heating valve open	Heating valve open	Heating valve open	NA
			Face bypass heat isolation valve	Normally open or normally closed
	Electric heat stage[a]	Electric heat stage[a]	Electric heat stage[a]	NA
	2-position heating	2-position heating	2-position heating	Normally open or normally closed

Table 43. Binary outputs (continued)

Binary output	Fan coil	Blower coil	Unit vent	Valid range
J1-10	Heating valve close	Heating valve close	Heating valve close	NA
	Electric heat stage(b)	Electric heat stage(b)	Electric heat stage(b)	NA
J1-11	Outdoor air damper open	Outdoor air damper open	Outdoor air damper open	NA
J1-12	Outdoor air camper close	Outdoor air camper close	Outdoor air camper close	NA

(a) Trane's Rover service tool uses the unit type to determine and download the proper default binary output configuration.
(b) The normally open/closed configuration item refers to the inactive state of the controlled end device (such as an 2-position cooling valve output).

Table 44. TB4-1 and TB4-2 output rating

Description	Terminals	Output Rating	Load Energized	Load De-energized
Generic/baseboard heat output	TB4-1	12 VA	1 VAC rms (typical)	24 VAC rms(typical)
24 VAC	TB4-2	12 VA	NA	NA

Table 45. Binary inputs(a)

Binary input	Configuration	Valid range(b)
BI 1	Low coil temperature detection or not used	Normally open Normally closed
BI 2	Condensate overflow or not used	Normally open Normally closed
BI 3	Occupancy, generic, or not used	Normally open Normally closed
BI 4	Fan status or not used	Normally open Normally closed

(a) Trane's Rover service tool uses the unit type to determine and download the proper default binary input configuration.
(b) The normally open/closed configuration item refers to the inactive state of the input end device, such as a freezestat or a condensate float switch. If the device is a normally closed condensate float switch, the configuration for binary input 2 must be normally closed.

Table 46. Analog inputs(a)

Analog input	Configuration	Calibration range
Zone	Space temperature	+/– 10.0°F (0.1°F resolution)
Set	Setpoint (hardwired)	+/– 10.0°F (0.1°F resolution)
Fan	Fan switch	NA
AI 1	Entering water temperature	NA
AI 2	Discharge air temperature	NA
AI 3	Outdoor air temperature or generic temperature input(b)	NA
AI 4	Humidity, CO_2 or generic 4-20mA input	NA

(a) Trane Rover service tool uses the unit type to determine and download the proper default analog input configuration.
(b) Analog input 3 (AI 3) configured as generic temperature input does not affect unit operation. When configured, the Tracer ZN520 zone controller communicates the generic temperature value to Rover or Tracer Summit and displays it as generic temperature.

Table 47. Fan configurations

Configuration	Valid range
Fan operation in heating	Cycling with capacity(unoccupied) Continuous (during occupied)

Table 47. Fan configurations (continued)

Configuration	Valid range
Fan operation in cooling	Cycling with capacity(unoccupied) Continuous (during occupied)
Number of fan speeds	1, 2, 3
Default fan speed heating	Off, low, medium, high, auto
Default fan speed cooling	Off, low, medium, high, auto
Zone sensor fan switch	Disable or enable

Table 48. End device configurations

Configuration	Valid range
Main, cooling/changeover valve stroke time	30–360 seconds
Entering water sampling	Disable or enable
Auxiliary, heating valve stroke time	30–360 seconds
Outdoor air damper stroke time	30–360 seconds
Occupied outdoor damper position	0–100%
Occupied standby damper position	0–100%
Alternate damper position for low fan speed	0–100%
Economizer enable temperature	30–70°F
Exhaust fan enable setpoint[a]	0–100%, 101% disables the exhaust fan

(a) The exhaust fan is energized when the outdoor air damper is equal to or greater than the exhaust fan enable point, and the exhaust fan is turned off when the outdoor air damper is 10% less than the exhaust fan enable point.

Table 49. Default setpoints

Configuration	Valid range
Occupied heating setpoint	40–115°F
Occupied cooling setpoint	40–115°F
Occupied standby heating setpoint	40–115°F
Occupied standby cooling setpoint	40–115°F
Unoccupied heating setpoint	40–115°F
Unoccupied cooling setpoint	40–115°F
Heating setpoint low limit	40–115°F
Cooling setpoint low limit[a]	40–115°F
Heating setpoint high limit[a]	40–115°F
Cooling setpoint high limit[a]	40–115°F
Thumbwheel setpoint	Disable or enable

(a) The heating and cooling setpoint high and low limits only apply to the occupied and occupied standby setpoints and are never applied to the unoccupied setpoints.

Table 50. Discharge air limits

Configuration	Valid range
Low limit[a]	30–50°F
Control point high limit[b]	38–150°F
Control point low limit[b]	35–150°F

(a) The low limit is the temperature at which the controller shuts down the unit to prevent the coil from freezing.
(b) The control algorithm is limited to calculating this discharge air temperature.

Table 51. Freeze avoidance

Configuration	Valid range
Freeze avoidance setpoint	20 to 60°F

Table 52. Occupied bypass timer

Configuration	Valid range
Occupancy bypass timer[a]	0–240 minutes (1 minute resolution)

(a) The occupied bypass timer is used for timed override applications when a building automation system is not present or when the building automation system does not send the occupied (override) request. The timed override timer is maintained in the unit controller. When the timed override is applicable, the controller reports Occupied Bypass as its effective occupancy mode. (The actual enumeration of nvoEffectOccup is OC_BYPASS during the override condition.)

Table 53. Power-up control wait

Configuration	Valid range
Power up control wait (2 minutes)	Disable or enable

Table 54. Maintenance timer

Configuration	Valid range
Maintenance timer	0–10,000 hours

Application Information

The Tracer ZN520 zone controller includes unit configuration for a location identifier. The maximum length of the location identifier is 30 characters. You can use Rover service tool to download this identifier and easily identify the unit based on its physical location.

Stand-Alone

Occupied/Unoccupied

You can configure the controller's binary input 3 (BI 3) as an occupancy input to switch between occupied and unoccupied. When BI 3 is configured as a normally open occupancy input, the stand-alone controller switches to occupied mode when BI 3 contacts are open.

Timed Override

The range for the timed override is 0–240 minutes (configurable). The default value is 120 minutes.

The controller's space temperature analog input generates timed override On and Cancel requests in the following manner. The controller interprets a momentary short (0.2–5 seconds) by the space temperature input as a timed override On request. The controller always accepts this timed override On request, but only changes to occupied bypass if the controller was supposed to be in unoccupied mode. During unoccupied mode, the On request places the controller in occupied bypass mode for the occupied bypass time (configurable) or until someone presses the zone sensor's Cancel button.

The controller interprets a momentary fixed resistance (0.2–25 seconds) of 1.5 kW by the space temperature input as a timed override Cancel request. The controller always accepts the Cancel request, but only acts on a Cancel request during occupied bypass. During occupied bypass mode, the stand-alone controller uses a Cancel request to return the controller to unoccupied mode.

Configuration

Use Rover service tool to modify the controller's configuration parameters, including the default setpoints.

Setpoint Operation

Stand-alone zone controllers can use two different setpoint sources: the local (hardwired) setpoint input or the default setpoints. Use the local setpoint input to provide the controller with a single setpoint, from which all other heating and cooling setpoints are derived.

- The controller's default setpoints are:
- Unoccupied cooling
- Occupied standby cooling
- Occupied cooling
- Occupied heating
- Occupied standby heating
- Unoccupied heating

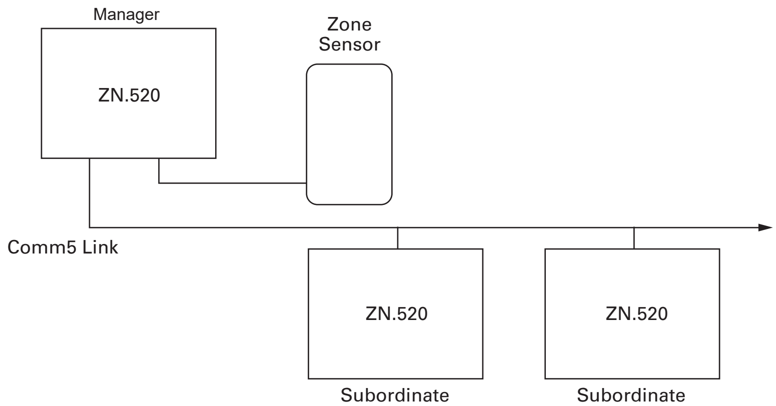
The controller uses the appropriate setpoint based on the controller's occupancy and heating/cooling modes.

A configuration parameter exists in the controller to enable or disable the local setpoint input. Use Rover service tool to modify this and all other unit configuration items.

Stand-Alone Peer-to-Peer

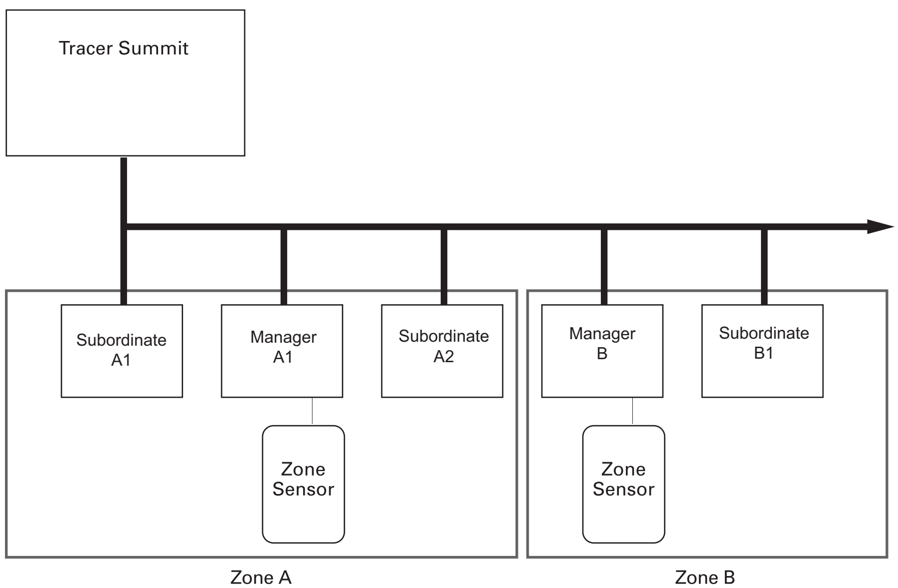
Tracer ZN520 zone controller allows peer-to-peer (also referred to as manager/subordinate) data communication. Data such as space temperature, setpoint, and occupancy can be shared from a manager control to a peer control with or without the presence of Tracer Summit. This communication allows all units to operate with the same data to prevent conflicts between units. See Figure 6.

Figure 6. Simple data sharing application



In Figure 7, multiple manager and subordinate controllers are connected on the same Comm5 communication link with Tracer Summit. The manager for Zone A is the only controller with a zone sensor. Manager A communicates data to subordinate controllers A1 and A2. Connected to the same communication link, the manager controller for Zone B is connected to the zone sensor and communicates data to subordinate B1.

Figure 7. Complex data sharing application



Occupied/Unoccupied

You can configure the controller's binary input 3 (BI 3) as an occupancy input. As an occupancy input, the stand-alone controller uses binary input 3 to switch between occupied and unoccupied. When BI 3 is configured as a normally open occupancy input, the stand-alone controller switches to occupied mode when BI 3 contacts are open.

The manager controller (the zone controller with the hardwired occupancy input) in peer-to-peer communication can send its occupancy mode to one or more subordinate controllers (so they all track each other's occupancy mode). For these applications, you must use Rover service tool to set up the controller. Refer to the Rover service tool product literature for more information.

Timed Override

Peer-to-peer timed override requires at least two controllers. The first controller, commonly referred to as the manager, passes occupancy information to other controllers, commonly referred to as subordinates.

The manager controller's space temperature analog input generates timed override on and cancel requests in the following manner. The manager controller interprets a momentary short (0.2–5 seconds) by the space temperature input as a timed override On request. During unoccupied mode, the On request places the manager controller in occupied bypass mode until the occupied timer expires or until someone presses the zone sensor's Cancel button.

When the manager controller's occupancy mode is communicated to one or more subordinate controllers, the subordinate controllers echo the manager's occupancy mode, including both On and Cancel requests. The controller interprets a momentary fixed resistance (0.2–25 seconds) of 1.5 kW by the space temperature input as a timed override Cancel request. During occupied bypass mode, the controller uses a Cancel request to return the controller to unoccupied mode.

Setpoint Operation

Controllers sharing information peer-to-peer (also referred to as manager/subordinate) can share a variety of data, including the heating/cooling setpoint (communicated from a manager to a subordinate).

Note: *Each controller derives its effective setpoint and default setpoints (including deadbands between setpoints) from the setpoint input (hardwired or communicated). To make sure the peer-to-peer setpoint application results in identical setpoints for each communicating controller, each controller must have exactly the same default setpoints.*

The stand-alone manager controller derives its setpoint from either the local hardwired setpoint input (if present) or from its default setpoints. Peer-to-peer applications often require the use of one hardwired setpoint to be shared across two or more controllers. You can achieve this by wiring the adjustable setpoint (typically included as a part of the Trane zone sensor module) to one controller—defined as the manager. Next, use Rover to set up the manager and one or more subordinates to share that setpoint. For this application, each communicating controller uses the same setpoint.

Simplified Peer-to-Peer (Manager/Subordinate) Setup

To achieve synchronous unit operation in manager/subordinate setups, the manager and subordinate units should be the same unit type and contain the same controller configuration.

To simplify setting up manager/subordinate applications, the controller provides information that groups all necessary shared data into one communication variable (nvoMstrSlv3). This manager/subordinate variable includes the following information, which is communicated from the manager to the subordinate to ensure similar unit operation:

- Space temperature
- Setpoint
- Heating/cooling mode
- Occupancy
- Fan speed
- Entering water temperature
- Economizer
- Proprietary unit control algorithm coordination data

Use Rover service tool to set up peer-to-peer applications. Refer to the Rover Installation, Operation, and Programming guide (EMTX-SVX01*-EN) for more information on setting up applications.

Troubleshooting

LED Operation

Red Service LED

Table 55. 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 is pressing the Service push button or the controller has failed.
LED flashes about once every second.	Uninstall (normal controller mode). Use Rover service tool to restore the unit to normal operation. Refer to the Rover product literature for more information.

Black Service Push Button

The Service push button, located at the bottom center of the controller, can be used to install the Tracer ZN520 zone controller in a communication network. Refer to the Rover service tool product literature for more information.

Important: *If the Service push button is held down for more than 15 seconds, the Tracer ZN520 zone controller will uninstall itself from the ICS communication network and shut down all unit operation. This mode is indicated by the red Service LED flashing once every second. See Table 56, p. 64. Use Rover service tool to restore the unit to normal operation. Refer to the Rover Installation, Operation, and Programming guide (EMTX-SVX01*-EN) for more information.*

Green Status LED

The green LED normally indicates whether or not the controller is powered on (24 VAC). The green LED is also used to indicate that the controller is in a manual test mode or wink mode. Table 57, p. 65 describes the different patterns.

Table 56. Green status LED activity

Green LED activity	Description
LED is on continuously.	Power on (normal operation).
LED blinks (one blink).	The controller is in manual output test mode. No diagnostics present.
LED blinks (2 blinks).	The controller is in manual output test mode. One or more diagnostics are present[(a)].
LED blinks (1/4 second on, 1/4 second off for 10 seconds).	Wink mode[(b)].
LED off.	Power is off. Controller failure. Test button is pressed.

(a) During manual output test, certain diagnostics make the status LED light in a two-blink pattern. Refer to the Table 58, p. 65 for a list of two-blink diagnostics. If a two-blink pattern remains after an attempt to clear diagnostics, the diagnostic condition is still present and may affect the manual output test. The diagnostic must then be cleared using another method. Refer to “Resetting Diagnostics” on page 68.

(b) The Wink feature allows you to identify a controller. By sending a request from Rover service tool, you can request the controller to wink (blink on and off as a notification that the controller received the signal). The green LED blinks (1/4 second on, 1/4 second off for 10 seconds) during Wink mode.

Yellow Comm LED

The yellow Comm LED blinks at the rate the controller receives communication. The yellow LED does not blink when the controller is transmitting communication data. Table 57, p. 65 describes the different patterns.

Table 57. Yellow Comm LED activity

Yellow LED activity	Description
LED off continuously.	The controller is not detecting any communication. (Normal for stand-alone applications.)
LED blinks or flickers.	The controller detects communication. (Normal for communicating applications, including data sharing.)
LED on continuously.	Abnormal condition or extremely high traffic on the link.

Manual Output Test

The test sequence verifies output and end device operation. The manual output test can be conducted to verify output wiring and actuator operation without using Rover service tool.

Many service calls are initiated due to diagnostics, so the test sequence attempts to clear diagnostics and restore normal unit operation prior to testing the outputs. If the diagnostics remain after an attempt to clear diagnostics, the status LED lights in a two-blink pattern, indicating the diagnostic condition is still present. See Table 61, p. 69 for information on diagnostics that cause a two-blink pattern.

Manual test is terminated by advancing completely through the test sequence. The controller will time out if the unit remains in a single step for one hour. Table 59, p. 66 and Table 60, p. 67 describe the controller output states for supported unit types.

Test Procedure

The procedure for testing is:

1. Press and hold the Test button for at least two seconds, then release the button to start the test mode. When manual output test mode begins, the controller turns off all outputs and calibrates modulating end devices closed.
2. Press the Test button (no more than once per second) to advance through the test sequence.

Alternatively, the manual output test can be controlled over the communications network by using the Rover service tool. When conducting the manual output test via communications network, the sequence must start with Step 1 (Off), as shown in the following table. However, subsequent steps may be conducted in any order.

Table 58. Test sequence for non-face and bypass unit configurations

Step	Fan			DX, or cool or heat/cool changeover valve		Face/ bypass damper		Electric heat, or heat valve		Outdoor air damper		Generic/ baseboard heat
	J1-1	J1-2	J1-3	J1-5	J1-6	J1-7	J1-8	J1-9	J1-10	J1-11	J1-12	TB4-1
1: Off[a]	Off	Off	Off	Off	On	NA	NA	Off	Hydronic: on EH: off	Off	On	Off
2: Fan high[b]	High	Off	Off	Off	Off	NA	NA	Off	Off	Off	Off	Off
3: Fan med[c]	Off	Med	Off	Off	Off	NA	NA	Off	Off	Off	Off	Off
4: Fan low[d]	Off	Off	Low	Off	Off	NA	NA	Off	Off	Off	Off	Off
5: Main open, DX on	High	Off	Off	On	Off	NA	NA	Off	Off	Off	Off	Off
6: Main close, DX off, aux open, EH1 on	High	Off	Off	Off	On	NA	NA	On	Off	Off	Off	Off
7: Aux open, EH1 on, exhaust fan[e]	High	Exh	Off	Off	Off	NA	NA	On	Off	Off	Off	Off
8: Aux close, EH1 off, EH2 on, damper open	High	Off	Off	Off	Off	NA	NA	Off	On	On	Off	Off
9: Damper close	High	Off	Off	Off	Off	NA	NA	Off	Off	Off	On	Off

Table 58. Test sequence for non-face and bypass unit configurations (continued)

Step	Fan			DX, or cool or heat/cool changeover valve		Face/ bypass damper		Electric heat, or heat valve		Outdoor air damper		Generic/ baseboard heat
	J1-1	J1-2	J1-3	J1-5	J1-6	J1-7	J1-8	J1-9	J1-10	J1-11	J1-12	TB4-1
10: Generic/ baseboard heat energized	High	Off	Off	Off	Off	NA	NA	Off	Off	Off	Off	On
11: Exit[f]												

(a) Upon entering manual output test mode, the controller turns off all fan and electric heat outputs and drives all dampers and valves closed (if required).
(b) At the beginning of step 2, the controller attempts to clear all diagnostics.
(c) If the unit is configured for a 3-speed fan, the medium fan speed output will energize at step 3. If the unit is configured for a 2-speed fan, the fan remains on high speed at step 3.
(d) If the unit is configured for a 3-speed fan, the medium fan speed output energizes at step 3. If the unit is configured for a 2-speed fan, the low fan speed output energizes at step 3. If the unit is configured for a 1-speed fan, the fan remains on high speed at step 3.
(e) If the unit is configured for a 1- or 2-speed fan, the exhaust fan output energizes on step 7. The exhaust fan output is shared with medium fan speed.
(f) After step 10, the test sequence performs an exit. This initiates a reset and attempts to return the controller to normal operation.

Table 59. Test sequence for face/bypass unit configurations

Step	Fan			DX, or cool or heat/ cool changeover valve		Face/ bypass damper		Electric heat, or heat valve		Outdoor air damper		Generic/ baseboard heat
	J1-1	J1-2	J1-3	J1-5	J1-6	J1-7	J1-8	J1-9	J1-10	J1-11	J1-12	TB4-1
1: Off[a]	Off	Off	Off	Off	NA	Off	On	Off	NA	Off	On	Off
2: Fan high[b]	High	Off	Off	Off	NA	On	Off	Off	NA	Off	Off	Off
3: Fan med[c]	Off	Med	Off	Off	NA	On	Off	Off	NA	Off	Off	Off
4: Fan low[d]	Off	Off	Low	Off	NA	On	Off	Off	NA	Off	Off	Off
5: Main open, DX on	High	Off	Off	On	NA	On	Off	Off	NA	Off	Off	Off
6: Main close, DX off, aux open	High	Off	Off	Off	NA	On	Off	On	NA	Off	Off	Off
7: Aux open, exhaust fan[e]	High	Exh	Off	Off	NA	On	Off	On	NA	Off	Off	Off
8: Aux close, damper open	High	Off	Off	Off	NA	Off	On	Off	NA	On	Off	Off
9: Outdoor air damper close	High	Off	Off	Off	NA	Off	On	Off	NA	Off	On	Off
10: Generic/ baseboard heat energized	High	Off	Off	Off	NA	Off	On	Off	NA	Off	Off	On
11: Exit[f]												

(a) Upon entering manual output test mode, the controller turns off all fan outputs and drives all dampers and valves closed (if required).
(b) At the beginning of step 2, the controller attempts to clear all diagnostics.
(c) If the unit is configured for a 2-speed fan, the fan remains on high speed at step 3.
(d) If the unit is configured for a 2-speed fan, the low fan speed output energizes at step 3. If the unit is configured for a 1-speed fan, the fan remains on high speed at step 3.
(e) If the unit is configured for a 1- or 2-speed fan, the exhaust fan output energizes on step 7. The exhaust fan output is shared with medium fan speed.
(f) After step 10, the test sequence performs an exit. This initiates a reset and attempts to return the controller to normal operation.

Minimum Timers

Note: *The controller automatically exits the manual test mode after one hour and reverts back to normal operation.*

The outputs are not subject to minimum times during the test sequence. However, the test sequence only permits one step per second, which enforces a minimum output time.

LED Operation

The green status LED is off when you press the Test button. To begin the manual output test mode, press and hold the Test button (which causes the green LED to go off) for at least two seconds, then release the button. The green LED blinks, indicating the controller is in manual test mode.

Diagnostics

Table 60. Tracer ZN520 zone controller diagnostics

Diagnostic	Fan	Other Outputs[a]
Condensate Overflow[b]	Off	Valves **Closed** Outdoor air damper **Closed** Face bypass damper **Bypass** DX/electric heat **Off** Baseboard heat **Off**
Low Coil Temperature Detect[b]	Off	Valves **Open** Outdoor air damper **Closed** Face bypass damper **Bypass** DX/electric heat **Off** Baseboard heat **Off**
Low AirFlow—Fan Failure[b]	Off	Valves **Closed** Outdoor air damper **Closed** Face bypass damper **Bypass** DX/electric heat **Off** Baseboard heat **Off**
Space Temperature Failure[b] [c]	Off	Valves **Closed** Outdoor air damper **Closed** Face bypass damper **Bypass** DX/electric heat **Off** Baseboard heat **Off**
Entering Water Temp Failure[c]	Enabled	Valves **Enabled**[d] Outdoor air damper **Enabled**[d] Face bypass damper **Enabled**[d] DX/electric heat **Enabled**[d] Baseboard heat **Off**
Discharge Air Temp Limit[b]	Off	Valves **Open** Outdoor air damper **Closed** Face bypass damper **Bypass** DX/electric heat **Off** Baseboard heat **Off**
Discharge Air Temp Failure[b] [c]	Off	Valves **Closed** Outdoor air damper **Closed** Face bypass damper **Bypass** DX/electric heat **Off** Baseboard heat **Off**
Outdoor Air Temp Failure[c]	Enabled	Valves **Enabled** Outdoor air damper **Minimum position**[e] Face bypass damper **Enabled** DX/electric heat **Enabled** Baseboard heat **Enabled**
Humidity Input Failure[c]	Enabled	Valves **Enabled** Outdoor air damper **Enabled** Face bypass damper **Enabled** DX/electric heat **Enabled** Baseboard heat **Enabled**
CO_2 Sensor Failure[c]	Enabled	Valves **Enabled** Outdoor air damper **Enabled** Face bypass damper **Enabled** DX/electric heat **Enabled** Baseboard heat **Enabled**
Generic AIP Failure[c]	Enabled	Valves **Enabled** Outdoor air damper **Enabled** Face bypass damper **Enabled** DX/electric heat **Enabled** Baseboard heat **Enabled**

Table 60. Tracer ZN520 zone controller diagnostics (continued)

Diagnostic	Fan	Other Outputs[a]
Defrosting - Cmpr Lockout[c] (defrosting and compressor lockout control)	Enabled	Valves **Enabled** Outdoor air damper **Enabled** Face bypass damper **Enabled** DX/electric heat **Off** Baseboard heat **Enabled**
Maintenance Required	Enabled	Valves **Enabled** Outdoor air damper **Enabled** Face bypass damper **Enabled** DX/electric heat **Enabled** Baseboard heat **Enabled**
Local Fan Mode Failure[c]	Enabled	Valves **Enabled** Outdoor air damper **Enabled** Face bypass damper **Enabled** DX/Electric Heat **Enabled** Baseboard heat **Enabled**
Local Setpoint Failure[c]	Enabled	Valves **Enabled** Outdoor air damper **Enabled** Face bypass damper **Enabled** DX/electric heat **Enabled** Baseboard heat **Enabled**
Generic Temperature Failure	Enabled	Valves **Enabled** Outdoor air damper **Enabled** Face bypass damper **Enabled** DX/electric heat **Enabled** Baseboard heat **Enabled**
Invalid Unit Configuration[b]	Disabled	Valves **Disabled** Outdoor air damper **Disabled** Face bypass damper **Disabled** DX/electric heat **Disabled** Baseboard heat **Disabled**
Normal	Enabled	Valves **Enabled** Outdoor air damper **Enabled** Face bypass damper **Enabled** DX/electric heat **Enabled** Baseboard heat **Enabled**

(a) The generic binary output (TB4-1, TB4-2) state is unaffected by all diagnostics.
(b) During manual output test, these diagnostics make the green status LED light in a two-blink pattern. Refer to "LED operation" on page 87 for more information on the two-blink pattern.
(c) These diagnostics are non-latching and automatically reset when the input is present and valid.
(d) When the entering water temperature is required but not present, the Tracer ZN520 zone 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 hydronic cooling operation, but allows the delivery of heat when heating is required. In the Cool mode, all hydronic cooling is locked out, but normal fan and outdoor air damper operation is permitted.
(e) When the outdoor air temperature sensor has failed or is not present, the Tracer ZN520 zone controller generates a diagnostic to indicate the sensor loss condition. The controller automatically clears the diagnostic once a valid outdoor air temperature value is present (non-latching diagnostic). When the outdoor air temperature sensor fails or is not present, the controller prohibits economizer operation. A value of Enable or Disable for nviEconEnable overrides these decisions, regardless of the presence of an outdoor air temperature value or failure.

Translating Multiple Diagnostics

Note: *If the Tracer ZN520 zone controller is configured for economizing, Tracer Summit can enable or disable economizing. If the Tracer ZN520 zone controller is not configured for economizing, Tracer Summit cannot enable economizing.*

The controller senses and records each diagnostic independently of other diagnostics. It is possible to have multiple diagnostics present simultaneously. The diagnostics are reported in the order they occur.

Resetting Diagnostics

There are many ways to reset diagnostics:

- Automatically by the controller

- By initiating a manual output test at the controller
- By cycling power to the controller
- By using a building automation system
- By using the Rover service tool
- By using any other communicating device able to access the controller's diagnositc reset input
- By cycling the fan switch from off to any speed setting

Automatically: The Tracer ZN520 zone controller includes an automatic diagnostic reset function. This function attempts to automatically recover a unit when the Low Coil Temperature Detection diagnostic occurs. When this diagnostic occurs, the controller responds as defined in Table 58, p. 65.

After the controller detects the Low Coil Temperature Detection diagnostic, the unit waits 30 minutes before invoking the automatic diagnostic reset function. The automatic diagnostic reset function clears the Low Coil Temperature Detection diagnostic and attempts to restore the controller to normal operation. The controller resumes normal operation until another diagnostic occurs.

If a Low Coil Temperature Detection diagnostic recurs within 24 hours after an automatic diagnostic reset, you must manually reset the diagnostic. See other possible methods for resetting diagnostics in this section.

Manual output test: You can use the Test button on the controller either during installation to verify proper end device operation or during troubleshooting. When you press the Test button, the controller exercises all outputs in a predefined sequence. The first and last steps of the sequence reset the diagnostics. For more information, see “Manual Output Test,” p. 65.

Cycling power: When someone turns off the controller's 24 VAC power, then re-applies power, the unit cycles through a power-up sequence. By default, the controller attempts to reset all diagnostics at power-up. Diagnostics present at power-up and those that occur after power-up are handled according to the defined diagnostics sequences. See Table 59, p. 66.

Building automation system: Some building automation systems can reset diagnostics in the Tracer ZN520 zone controller. For more complete information, refer to the product literature for the building automation system.

Rover service tool: The Rover service tool can reset diagnostics in the Tracer ZN520 zone controller. For more complete information, refer to the Rover Installation, Operation, and Programming guide (EMTX-SVX01*-EN).

Diagnostic reset: Any device that can communicate the network variable *nviRequest* (enumeration “clear_alarm”) can reset diagnostics in the Tracer ZN520 zone controller. The controller also attempts to reset diagnostics whenever power is cycled.

Cycling the fan switch: If the user cycles the fan speed switch from off to any speed, the controller resets all diagnostics. Diagnostics may recur immediately if the problem still exists.

Questionable Unit Operation

Table 61. Fan outputs do not energize

Probable cause	Explanation
Unit wiring	The wiring between the controller outputs and the fan relays and contacts must be present and correct for normal fan operation.
No power to the controller	If the controller does not have power, the unit fan does not operate. For the Tracer ZN520 zone controller to operate normally, it must have an input voltage of 24 VAC. When the green LED is off continuously, the controller does not have sufficient power or has failed.
Unit configuration	The controller must be properly configured based on the actual installed end devices and application. When the unit configuration does not match the actual end devices, the fans may not work correctly.
Random start observed	After power-up, the controller always observes a random start from 5 to 30 seconds. The controller remains off until the random start time expires.

Table 61. Fan outputs do not energize (continued)

Probable cause	Explanation
Power-up control wait	When power-up control wait is enabled (non-zero time), the controller remains off until one of two conditions occurs: The controller exits power-up control wait once it receives communicated information. The controller exits power-up control wait once the power-up control wait time expires.
Diagnostic present	A specific list of diagnostics affects fan operation. For more information, see Table 58, p. 65.
Manual output test	The controller includes a manual output test sequence you can use to verify output operation and associated output wiring. However, based on the current step in the test sequence, the unit fan may not be on. See "Manual Output Test," p. 51.
Fan mode off	When a local fan mode switch (provided on the Trane zone sensor) determines the fan operation, the off position controls the unit off.
Requested mode off	You can communicate a desired operating mode (such as off, heat, and cool) to the controller. When off is communicated to the controller, the unit controls the fan off. There is no heating or cooling.
Unoccupied operation	When the controller is in the unoccupied mode, the fan is cycled.
Cycling fan operation/continuous	The controller operates the fan continuously when in the occupied, occupied standby, or occupied bypass mode. When the controller is in the unoccupied mode, the fan is cycled between high speed and off with capacity.

Table 62. Valves stay closed

Probable cause	Explanation
Unit wiring	The wiring between the controller outputs and the valve(s) must be present and correct for normal valve operation.
Random start observed	After power-up, the controller always observes a random start from 5–30 seconds. The controller remains off until the random start time expires.
Unit configuration	The controller must be properly configured based on the actual installed end devices and application. When the unit configuration does not match the actual end devices, the valves may not work correctly.
Power-up control wait	When power-up control wait is enabled (non-zero time), the controller remains off until one of two conditions occurs: The controller exits power-up control wait once it receives communicated information. The controller exits power-up control wait once the power-up control wait time expires.
Diagnostic present	A specific list of diagnostic affects valve operation. See Table 58, p. 65.
Manual output test	The controller includes a manual output test sequence you can use to verify output operation and associated output wiring. However, based on the current step in the test sequence, the valve(s) may not be open. Refer to "Manual Output Test," p. 65.
Fan mode off	When a local fan mode switch (provided on the Trane zone sensor) determines the fan operation, the Off position controls the unit off and valves to close.
Requested mode off	You can communicate a desired operating mode (such as off, heat, and cool) to the controller. When Off is communicated to the controller, the unit controls the fan off. There is no heating or cooling (valves are closed).
Sampling logic	The controller includes entering water temperature sampling logic which is automatically invoked during 2-pipe and 4-pipe changeover when the entering water temperature is either too cool or too hot for the desired heating or cooling. Refer to "Entering Water Temperature Sampling Function," p. 44. **Example**: A 2-pipe heat/cool changeover unit will not cool if the entering water temperature is too warm for cooling or if the entering water sensor is not present. The unit will not heat if the entering water temperature is too cool for heating. If failed the controller will close valve for one hour then re-attempt sampling routine.

Table 63. Valves stay open

Probable cause	Explanation
Unit wiring	The wiring between the controller outputs and the valve(s) must be present and correct for normal valve operation.
Unit configuration	The controller must be properly configured based on the actual installed end devices and application. When the unit configuration does not match the actual end devices, the valves may not work correctly.
Diagnostic present	A specific list of diagnostic affects valve operation. For more information, see Table 58, p. 65.
Manual output test	The controller includes a manual output test sequence you can use to verify output operation and associated output wiring. However, based on the current step in the test sequence, the valve(s) may be open. Refer to "Manual Output Test," p. 65.
Sampling logic	The controller includes entering water temperature sampling logic which automatically invoked during 2-pipe and 4-pipe changeover when the entering water temperature is either too cool or too hot for the desired heating or cooling. Refer to "Entering Water Temperature Sampling Function," p. 44.
Freeze avoidance	When the fan is off with no demand for capacity (0%) and the outdoor air temperature is below the freeze avoidance setpoint, the controller opens the water valves (100%) to prevent coil freezing. This includes unoccupied mode when there is no call for capacity or any other time the fan is off.
Normal operation	The controller opens and closes the valves to meet the unit capacity requirements.

Table 64. DX or electric output(s) does not energize

Probable cause	Explanation
Unit wiring	The wiring between the controller outputs and the end devices must be present and correct for normal operation.
Unit configuration	The controller must be properly configured based on the actual installed end devices and application. When the unit configuration does not match the actual end devices, the unit may not work correctly.
Diagnostic present	A specific list of diagnostics affect compressor and electric heat operation. For more information, see Table 58, p. 65.
Manual output test	The controller includes a manual output test sequence you can use to verify output operation and associated output wiring. However, based on the current step in the test sequence, the DX or electric outputs may be off. Refer to "Manual Output Test," p. 65.
Freeze avoidance	When the fan is off with no demand for capacity (0%) and the outdoor air temperature is below the freeze avoidance setpoint, the controller disables compressors and electric heat outputs. This includes unoccupied mode when there is no call for capacity or any other time the fan is off.
Normal operation	The controller energizes the outputs only as needed to meet the unit capacity requirements.

Table 65. Outdoor air damper stays closed

Probable cause	Explanation
Unit wiring	The wiring between the controller outputs and the outdoor air damper must be present and correct for normal damper operation.
Unit configuration	The controller must be properly configured based on the actual installed end devices and application. When the unit configuration does not match the actual end devices, the damper may not work correctly.
Random start observed	After power-up, the controller always observes a random start from 5 to 30 seconds. The controller remains off until the random start time expires.
Power-up control wait	When power-up control wait is enabled (non-zero time), the controller remains off until one of two conditions occurs: The controller exits power-up control wait once it receives communicated information. The controller exits power-up control wait once the power-up control wait time expires.
Diagnostic present	A specific list of diagnostics affects outdoor air operation. For more information, see Table 58, p. 65.
Manual output test	The controller includes a manual output test sequence you can use to verify output operation and associated output wiring. However, based on the current step in the test sequence, the unit damper may not be open. Refer to "Manual Output Test," p. 65.
Fan mode off	When a local fan mode switch (provided on the Trane zone sensor) determines the fan operation, the off position controls the unit off and damper to close.
Requested mode off	You can communicate a desired operating mode (such as off, heat, and cool) to the controller. When off is communicated to the controller, the unit controls the fan off. There is no heating or cooling (valves are closed).

Table 65. Outdoor air damper stays closed (continued)

Probable cause	Explanation
Freeze avoidance	When the fan is off and the outdoor air temperature is below the freeze avoidance setpoint, the controller disables economizing and keeps the outdoor air damper closed. This includes unoccupied mode when there is no call for capacity or any other time the fan is off.
Unoccupied mode	When the controller is in the unoccupied mode, the outdoor air damper remains closed unless economizing is enabled.
Warm-up and cool-down sequence	The controller includes both a morning warm-up and cool-down sequence to keep the outdoor air damper closed during the transition from unoccupied to occupied. This is an attempt to bring the space under control as quickly as possible.
Normal operation	The controller opens and closes the outdoor air damper based on the controller's occupancy mode and fan operation. Normally, the outdoor air damper is open during occupied, occupied standby, and occupied bypass mode when the fan is running and closed during unoccupied mode unless the controller is economizing. Refer to "Modulating Outdoor Air Damper Operation," p. 49 for more information.

Table 66. Outdoor air damper stays open

Probable cause	Explanation
Unit wiring	The wiring between the controller outputs and the outdoor air damper must be present and correct for normal damper operation.
Unit configuration	The controller must be properly configured based on the actual installed end devices and application. When the unit configuration does not match the actual end devices, the damper may not work correctly.
Manual output test	The controller includes a manual output test sequence you can use to verify output operation and associated output wiring. However, based on the current step in the test sequence, the unit damper may be open. Refer to "Manual Output Test," p. 65.
Normal operation	The controller opens and closes the outdoor air damper based on the controller's occupancy mode and fan operation. Normally, the outdoor air damper is open during occupied, occupied standby, and occupied bypass mode when the fan is running and closed during unoccupied mode unless the controller is economizing. Refer to "Modulating Outdoor Air Damper Operation," p. 49 for more information.

Appendix

Hardwired Setpoint Adjustment

Table 67. Hardwired setpoint adjustment

Resistance (Ω)	Setpoint (°F)
889.4	50
733.6	58
577.9	66
500	70
422.1	74
344.2	78
266.4	82
188.5	86
110.6	90

Hardwired Thermistor Values

Table 68. Hardwired 10 kW thermistor values

Resistance (kΩ)	Temperature (°F)
87.5	0
74.6	5
63.8	10
54.6	15
46.9	20
40.4	25
34.8	30
30.2	35
26.2	40
22.8	45
20.0	50
17.5	55
15.3	60
13.5	65
11.9	70
10.5	75

Resistance (kΩ)	Temperature (°F)
10.0	77
9.3	80
8.2	85
7.3	90
6.5	95
5.8	100
5.2	105
4.7	110
4.2	115
3.8	120
3.4	125
3.1	130
2.8	135
2.5	140
2.3	145
2.1	150

Binary Configuration

Table 69. Binary configuration details

Binary input or output	Function	Configuration	Description
BI 1	Low temp detection	Normally closed	Closed: BIP 1 is Normal (no diagnostic) Open: BIP 1 is Active (diagnostic)
BI 2	Condensate overflow	Normally closed	Closed: BIP 2 is Normal (no diagnostic) Open: BIP 2 is Active (diagnostic)

Table 69. Binary configuration details (continued)

Binary input or output	Function	Configuration	Description
BI 3	Occupancy	Normally closed	Closed: BIP 3 is Normal (Occupied) Open: BIP 3 is Active (Unoccupied)[a]
		Normally open	Open: BIP 3 is Normal (Occupied) Closed: BIP 3 is Active (Unoccupied)[a]
BI 4	Fan status[b]	Normally open	When the controller commands the fan on and the binary input remains open for one minute, BIP is normal (diagnostic). When the controller commands the fan on and the binary input closes, BIP is active (no diagnostic).
Defrost	Defrost	NA	When input is Open, BIP is Active (Defrost activated) When input is Closed, BIP is Normal (no Defrost)
J1-1	Fan high	Normally open	De-energized: Fan off Energized: Fan high
J1-2	Fan medium	Normally open	De-energized: Fan off Energized: Fan medium
J1-3	Fan low	Normally open	De-energized: Fan off Energized: Fan low
TB4-1 and TB4-2	Generic binary output/base board heat	Normally open	De-energized: Output off (de-energized) Energized: Output on (energized)

(a) The occupancy input applications vary for stand-alone and communicated instances. For more information, see Table 31, p. 38.
(b) The fan status device is normally closed during normal fan operation. When the fan is off because of either a fan failure or the controller commanding the fan off, the binary input device opens.

Unit Operation Based on the Effective Heat/Cool Output

Table 70. Unit operation based on the effective heat/cool output

Application mode input (*nviApplicMode*)	Heat/cool mode input (*nviHeatCool*)	Effective heat/ cool mode output (*nvoHeatCool*)	Unit operation
Auto	Auto	Determined by controller	Fan-enabled Heating-enabled Cooling-enabled Damper-enabled
	Heat	Heat	Fan-enabled Heating-enabled Cooling-disabled Damper-enabled
	Morning warm up	Morning warm up	Fan-enabled Heating-enabled Cooling-disabled Damper-disabled
	Cool	Cool	Fan-enabled Heating-disabled[a] Cooling-enabled Damper-enabled
	Night purge[b]	Determined by controller	Fan-enabled Heating-enabled Cooling-enabled Damper-enabled
	Pre-cool	Pre-cool	Fan-enabled Heating-disabled[a] Cooling-enabled Damper-disabled

Table 70. Unit operation based on the effective heat/cool output (continued)

Application mode input (*nviApplicMode*)	Heat/cool mode input (*nviHeatCool*)	Effective heat/ cool mode output (*nvoHeatCool*)	Unit operation
	Off	Off	Fan-disabled Heating-disabled Cooling-disabled Damper-disabled
	Test	Test	Fan-enabled Heating-enabled Cooling-enabled Damper-enabled
	Emergency heat[b]	Determined by controller	Fan-enabled Heating-enabled Cooling-enabled Damper-enabled
	Fan only	Fan only	Fan-enabled Heating-disabled Cooling-disabled Damper-enabled
Auto	Not present	Determined by controller	Fan-enabled Heating-enabled Cooling-enabled Damper-enabled
Heat	Any state	Heating	Fan-enabled Heating-enabled Cooling-disabled Damper-enabled
Morning warm up	Any state	Morning warm up	Fan-enabled Heating-enabled Cooling-disabled Damper-disabled
Cool	Any state	Cool	Fan-enabled Heating-disabled[a] Cooling-enabled Damper
Pre-cool	Any state	Pre-cool	Fan-enabled Heating-disabled[a] Cooling-enabled Damper-disabled
Off	Any state	Off	Fan-disabled Heating-disabled Cooling-disabled Damper-disabled
Test	Any state	Determined by controller	Fan-enabled Heating-enabled Cooling-enabled Damper-enabled
Fan only	Any state	Fan only	Fan-enabled Heating-disabled Cooling-disabled Damper-enabled

(a) Use of heat for supply air tempering and dehumidification remains available.
(b) Night purge, Emergency heat, and Null modes are not supported by the Tracer ZN520 zone controller. If one of these modes is received by the controller, it is interpreted as Auto.

Data Lists

Table 71, p. 76 provides an input/output listing for the Tracer ZN520 zone controller.

Table 72, p. 76 provides the configuration properties for the zone controller. The content of the lists conforms to both the LonMark Space Comfort Controller Functional Profile 85.00 and the LonMark® node object.

Table 71. Input/output listing[(a)]

Input	SNVT type	Output	SNVT type
nviRequest	SNVT_obj_request	nvoStatus	SNVT_obj_status
nviSpaceTemp	SNVT_temp_p	nvoFileDirectory	SNVT_address
nviSetpoint	SNVT_temp_p	nvoSpaceTemp	SNVT_temp_p
nviSetptOffset	SNVT_temp_p	nvoUnitStatus	SNVT_hvac_status
nviOccSchedule	SNVT_tod_event	nvoEffectSetpt	SNVT_temp_p
nviOccManCmd	SNVT_occupancy	nvoEffectOccup	SNVT_occupancy
nviOccSensor	SNVT_occupancy	nvoHeatCool	SNVT_hvac_mode
nviApplicMode	SNVT_hvac_mode	nvoSetpoint	SNVT_temp_p
nviHeatCool	SNVT_hvac_mode	nvoDischAirTemp	SNVT_temp_p
nviFanSpeedCmd	SNVT_switch	nvoTerminalLoad	SNVT_lev_percent
nviComprEnable	SNVT_switch	nvoSpaceRH	SNVT_lev_percent
nviAuxHeatEnable	SNVT_switch	nvoOutdoorTemp	SNVT_temp_p
nviValveOverride	SNVT_hvac_overid	nvoSpaceCO2	SNVT_ppm
nviEmergOverride	SNVT_hvac_emerg	nvoEnterWaterTemp	SNVT_temp_p
nviSourceTemp	SNVT_temp_p		
nviSpaceRH	SNVT_lev_percent		

(a) LonMark® certification pending.

Table 72. Configuration properties[(a)]

Configuration property	SNVT type	SCPT reference	Description
nciSndHrtBt	SNVT_time_sec	SCPTmaxSendTime (49)	Send heartbeat
nciSetpoints	SNVT_temp_setpt	SCPTsetPnts (60)	Occupancy temperature setpoints
nciUnitType	SNVT_hvac_type	SCPThvacUnitType (169)	Unit type
nciMinOutTm	SNVT_time_sec	SCPTminSendTime (52)	Minimum send time
nciRcvHrtBt	SNVT_time_sec	SCPTmaxRcvTime (48)	Receive heartbeat
nciLocation	SNVT_str_asc	SCPTlocation (17)	Location label
nciBypassTime	SNVT_time_min	SCPTbypassTime (34)	Local bypass time
nciSpaceRHSetpt	SNVT_lev_percent		Space RH setpoint
nciOAMinPos	SNVT_lev_percent		Minimum outside air position during occupied mode

(a) LonMark® certification pending.

Notes

Trane - by Trane Technologies (NYSE: TT), a global climate innovator - creates comfortable, energy efficient indoor environments for commercial and residential applications. For more information, please visit trane.com or tranetechnologies.com.

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