Introduction

The Tracer ZN.511 and ZN.521 zone controllers provide digital control for several types of heating, ventilating, and air-conditioning (HVAC) equipment.

The Tracer ZN.511 controls:
- Water-source heat pumps
- Two-pipe hydronic fan coils
- Four-pipe hydronic fan coils
- Cabinet heaters with hydronic or single-stage electric heat

The Tracer ZN.521 controls:
- Unit ventilators
- Fan coils
- Cabinet heaters
- Blower coils

Tracer zone controllers operate as stand-alone devices or as part of a Trane Integrated Comfort system (ICS). The controllers communicate with a Tracer Summit building automation system via a LonTalk Comm5 communication link. Comm5 allows the controllers to operate in peer-to-peer configuration and to communicate with other compatible building control systems.

Trane offers a variety of wall-mounted zone sensors for Tracer controllers. Zone sensors come with any of the following options:
- Temperature setpoint thumbwheel
- Fan speed switch
- ON and CANCEL occupancy buttons
- A communications jack for the Rover service tool

™ ® The following are trademarks or registered trademarks of their respective companies: Windows from Microsoft Corporation; LonTalk and LonMark from Echelon Corporation; Integrated Comfort, Rover, Tracer, and Tracer Summit from Trane.
The Tracer ZN.511 zone controller provides digital control of fan coils and water-source heat pumps. The Tracer ZN.511 improves comfort control and provides stand-alone or networked building automation.

**Inputs and outputs**
Tracer ZN.511 inputs and outputs include:
- **Analog inputs**: zone temperature, entering or leaving water temperature, discharge air temperature, zone temperature setpoint, fan mode switch
- **Binary inputs**: occupancy, condensate overflow, fan status, low water temperature, low pressure protection, high pressure protection
- **Outputs**: water-source heat pump: compressor 1, compressor 2, two-position outside air damper, reversing valve, fan on/off
  - Fan coil: fan high, fan medium, fan low, 1 cool, 1 heat, two-position outside air damper
- **Generic points** for use with a Tracer Summit building automation system: binary input (shared with occupancy), binary output (shared with outside air damper)

The generic inputs pass information to the building automation system. They do not affect the operation of the unit. The generic binary output is controlled by the building automation system and its state is not changed by unit operation, even under a diagnostic shutdown.

**Features**

**Easy installation**
The controller can be installed in existing Trane and competitive HVAC equipment without major wiring changes, and clearly labeled screw terminals ensure that wires are connected quickly and accurately. A compact enclosure design simplifies installation in minimal space.

**Entering water temperature sampling**
A traditional system using a two-way control valve on a fan coil might not sense the correct entering water temperature during long periods when the control valve is closed. The Tracer ZN.511 solves this problem by opening the valve for three minutes to allow the water temperature to stabilize before the temperature is taken. This feature allows the use of two-way control valves to provide accurate two-pipe system changeover for 1 heat/1 cool applications.

**Automatic heat/cool mode determination**
The Tracer ZN.511 automatically determines whether heating or cooling is needed to maintain comfort levels, without the need to manually adjust unit controls. The controller measures the zone temperature and setpoint temperature, then uses a proportional/integral algorithm to maintain zone temperature at the setpoint.

**Occupied and unoccupied operation**
The occupancy input works with a motion (occupancy) sensor or time clock. A communicated value from a building automation system through the Comm5 link can also be used. The input allows the controllers to use unoccupied (setback) temperature setpoints.

**Random start**
This feature randomly staggers multiple-unit start-up to reduce electrical demand spikes.

**Warm-up and cool-down**
This feature is available when an outside air damper is installed. When the room temperature drifts too far from the setpoint, the controller temporarily closes the damper to bring the temperature to the desired setpoint as quickly as possible.

**Manual output test**
Pressing the test button on the controller exercises all binary outputs in sequence. This feature is an invaluable troubleshooting tool.

**Peer-to-peer communication**
Multiple controllers can share data when one or several slave controllers are bound to a single master controller. Shared data can include setpoint, zone temperature, mode, and fan status. Applications having more than one unit serving a single large space can benefit from this feature, which prevents multiple units from simultaneously heating and cooling.

**Interoperability**
The Tracer ZN.511 conforms to the LonMark Space Comfort Controller (SCC) profile and communicates via the LonTalk protocol. This allows it to work with other control systems that support LonTalk and the SCC profile.

**Continuous fan or fan-cycling operation**
Users can choose to have the fan run continuously at a given speed, or cycle on and off automatically by selecting the AUTO mode.

**Equipment protection**
The Tracer ZN.511 includes inputs that allow for the following equipment protection:
- Refrigerant high- and low-pressure protection to prevent the unit from operating with high/low refrigeration pressure levels (heat pump only)
- Compressor minimum on and off timers to extend compressor life by preventing short cycling (heat pump only)
- A condensate overflow switch to prevent water damage to the building
- Low-temperature detection to prevent compressor operation during abnormal conditions (heat pump) or coil freeze-up (fan coil)
Timed override
The timed override function for after hours operation allows users to request unit operation by the touch of a button on the unit zone sensor. Additionally, users can press the CANCEL button at any time to place the unit back into unoccupied mode.

Fan status
The controller monitors the fan output status as proof of airflow. This method is cost effective and commonly used on direct drive fan applications.

Filter maintenance
Filter maintenance status is based on the cumulative hours of operation of the unit fan. The controller has timers that can be reset, and when the time limit expires, Tracer Summit software or the Rover service tool indicates that unit maintenance is recommended.

Dimensions
The Tracer ZN.511 dimensions are shown in Figure 1.

Figure 1: Tracer ZN.511 dimensions
The Tracer ZN.521 zone controller provides digital control of fan coils, unit ventilators, and blower coils. The Tracer ZN.521 improves comfort control and provides stand-alone or networked building automation.

Inputs and outputs
Tracer ZN.521 inputs and outputs include:
- Analog inputs: zone temperature, space setpoint, fan speed, entering water temperature, discharge air temperature, outside air temperature, zone relative humidity
- Binary inputs: occupancy, low coil temperature detection, fan status, condensate overflow detection
- Outputs: Fan high, fan medium, fan low, exhaust fan on/off, cooling valve, heating valve, face and bypass damper, economizer damper, electric heat (two stages)
- Generic points for use with a Tracer Summit building automation system: binary input (shared with occupancy), binary output (shared with baseboard heat), two analog inputs (one shared with humidity sensor and often used with the optional carbon dioxide sensor, and the second shared with outdoor air temperature)

The generic inputs pass information to the building automation system. They do not affect the operation of the unit. The generic binary output is controlled by the building automation system and its state is not changed by unit operation, even under a diagnostic shutdown.

Features
Easy installation
The controller can be installed in existing Trane and competitive HVAC equipment without major wiring changes, and clearly labeled screw terminals ensure that wires are connected quickly and accurately. A compact enclosure design simplifies installation in minimal space.

Modulating control
The Tracer ZN.521 provides exceptional comfort control through hydronic valve and damper tri-state modulation and a proportional-integral control algorithm.

Cascade control
Cascade control differs from zone temperature control in that the unit resets the discharge air temperature to control the zone. Cascade control manages zone temperature more effectively than zone temperature control, in which the discharge air temperature can exceed comfort levels.

Entering water temperature sampling
Traditional equipment using a two-way control valve might not sense the correct entering water temperature during long periods when the control valve is closed. The Tracer ZN.521 solves this problem by opening the valve for three minutes to allow the water temperature to stabilize before the temperature is taken. This feature allows the use of two-way control valves to provide accurate two-pipe system changeover for 1 heat/1 cool applications.

Automatic heat/cool mode determination
The Tracer ZN.521 automatically determines whether heating or cooling is needed to maintain comfort levels, without the need to manually adjust unit controls. The controller measures the zone temperature and setpoint temperature, then uses a proportional/integral algorithm to maintain zone temperature at the setpoint.

Occupied and unoccupied operation
The occupancy input works with a motion (occupancy) sensor or time clock. A communicated value from a building automation system through the Comm5 link can also be used. The input allows the controllers to use unoccupied (setback) temperature setpoints.

Random start
This feature randomly staggered multiple-unit start-up to reduce electrical demand spikes.

Warm-up and cool-down
This feature is available when an outside air damper is installed. When the room temperature drifts too far from the setpoint, the controller temporarily closes the damper to bring the temperature to the desired setpoint as quickly as possible.

Manual output test
Pressing the test button on the controller exercises all binary outputs in sequence. This feature is an invaluable troubleshooting tool.

Peer-to-peer communication
Multiple controllers can share data when one or several slave controllers are bound to a single master controller. Shared data can include setpoint, zone temperature, mode, and fan status. Applications having more than one unit serving a single large space can benefit from this feature, which prevents multiple units from simultaneously heating and cooling.

Interoperability
The Tracer ZN.521 conforms to the LonMark Space Comfort Controller (SCC) profile and communicates via the LonTalk protocol. This allows it to work with other control systems that support LonTalk and the SCC profile.

Continuous fan or fan-cycling operation
Users can choose to have the fan run continuously at a given speed, or cycle on and off automatically by selecting the AUTO mode.

Equipment protection
The Tracer ZN.521 includes inputs that allow for the following equipment protection:
- A condensate overflow switch to prevent water damage to the building
- Low-temperature detection to help prevent coil freeze-up
- Discharge air temperature limiting to help prevent the coil from freezing

Automatic fan speed reset
Units set to AUTO operate at the default fan speeds (cooling and heating may have different default speeds). If the default fan speed is high, medium, or low, the unit operates accordingly.

If the default fan speed is set to AUTO, the fan operates at low speed most of the time. If the temperature exceeds the setpoint by more than 2°F, the controller changes the fan speed to medium or high. This allows the unit to operate at low speed whenever possible.
Automatic ventilation reset
Because ensuring proper ventilation rates is so important for indoor air quality, the Tracer ZN.521 is configured with two outside/fresh air damper minimum position setpoints for occupied operation. As the fan speed changes, the damper minimum position changes to maintain the correct ventilation rate.

Fan status
The Tracer ZN.521 has two methods of monitoring fan status. The first method monitors the fan output status on the unit controller. This method is typically used with direct fan applications.

The controller can also accept a binary input from a fan proof switch for belt driven applications. When fan operation is expected by the controller but not confirmed by the proof switch, a diagnostic message is generated and unit operation is disabled.

Filter maintenance
Filter maintenance status is based on the cumulative hours of operation of the unit fan. The controller has timers that can be reset, and when the time limit expires, Tracer Summit software or the Rover service tool indicates that unit maintenance is recommended.

Water valve override
This function causes all of the water valves in every unit to open simultaneously at a command from Tracer Summit software or the Rover service tool. This function reduces the time required for balancing the water distribution system.

Relative humidity input
An analog input can be configured as a relative humidity input. The controller can use this value to support the dehumidification function.

Active dehumidification
This feature keeps relative humidity levels within ASHRAE 62-89R guidelines to maximize comfort and minimize the risk of microbial growth and damage to the building or furnishings due to humidity. The controller can provide active dehumidification when the equipment includes a reheat coil and a humidity sensor.

CO₂ input
An analog input can be configured to measure CO₂. Tracer Summit can use the input in a variety of applications. This input has no direct effect on the operation of the controller.

Two-stage electric heat
The Tracer ZN.521 supports 1- or 2-stage electric heat operation for heating. To control the zone temperature, electric heat is cycled to control the discharge air temperature. The rate of cycling is dependent on the load in the space and the temperature of any incoming fresh air from the economizer.

Two-pipe changeover units with electric heat use electric heat when hot water is not available.

Economizing control
When the Tracer ZN.521 is configured for economizing control, it opens the outdoor damper to the calculated position to provide “free” cooling as required. If the damper is completely open and the setpoint is still not achieved, the cooling valve opens to satisfy load requirements. As cooling load requirements decrease, the valve closes until the setpoint is reached or the damper reaches its adjustable minimum position.

Dimensions
The Tracer ZN.521 dimensions are shown in Figure 2.

Figure 2: Tracer ZN.521 dimensions
Network architecture

Tracer zone controllers, shown in Figure 3, can operate on a Tracer Summit building automation system, on a peer-to-peer network, or as stand-alone devices. The Rover service tool can configure the controllers through the communication jack in a zone sensor or at any accessible location on the Comm5 link.

Figure 3: Tracer zone controllers network architecture

- **Tracer zone controllers as part of a building automation system**
  - Building control unit (BCU)
  - LonTalk Comm5 link
  - Zone sensor
  - ZN.511
  - ZN.511
  - ZN.521
  - Rover service tool
  - Unit ventilator
  - Water-source heat pump
  - Fan coil

- **Tracer zone controllers on a peer-to-peer network**
  - One zone sensor for multiple fan coils
  - ZN.511
  - ZN.511
Zone sensors are available in a variety of configurations with any of the following features:

- Temperature setpoint thumbwheel
- Temperature detection
- ON and CANCEL occupancy buttons
- Fan speed switch
- Communications jack for the Rover service tool

Table 1 describes the zone sensors available for Tracer zone controllers. Figure 4 shows three types of zone sensors for the Tracer ZN.511 and ZN.521 zone controllers.

Table 1: Tracer zone sensor options

<table>
<thead>
<tr>
<th>BAS order number</th>
<th>Use</th>
<th>Fan</th>
<th>Zone</th>
<th>Timed override buttons</th>
<th>Comm jack</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>High</td>
<td>Med</td>
<td>Low</td>
<td>Auto</td>
</tr>
<tr>
<td>4190 1087</td>
<td>Any</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4190 1088</td>
<td>Any</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4190 1090</td>
<td>Heat pump</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4190 1094</td>
<td>Heat pump</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4190 1095</td>
<td>Unit vent</td>
<td></td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>4190 1115</td>
<td>Fan coil</td>
<td></td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>4190 1116</td>
<td>Unit vent</td>
<td></td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>4190 1117</td>
<td>Any</td>
<td></td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
</tbody>
</table>

Figure 4: Zone sensors compatible with Tracer zone controllers
Figure 5 shows a general wiring diagram for the Tracer ZN.511 zone controller.

**Figure 5:** Tracer ZN.511 wiring diagram
Figure 6 shows a general wiring diagram for the Tracer ZN.521 zone controller.

Figure 6: Tracer ZN.521 wiring diagram
Specifications

Power
19–30 Vac (24 Vac nominal)
50/60 Hz
9 VA and 12 VA maximum per binary output utilized

Dimensions
6 7/8 in. L × 5 3/8 in. W × 2 in. H
[175 mm × 137 mm × 51 mm]

Operating environment
Temperature: 32 to 140°F [0 to 60°C]
Relative humidity: 5–95% non-condensing

Storage environment
Temperature: -40 to 185°F [-40 to 85°C]
Relative humidity: 5–95% non-condensing

Agency listings/compliance
CE—Immunity:
   EN 50082-1:1997
   EN 50082-2:1995
CE—Emissions:
   EN 50081-1:1992 (CISPR 22)
UL and C-UL listed:
   Energy management system
UL 94-5V (UL flammability rating for plenum use)
FCC Part 15, Class A
LonMark Space Comfort Controller (SCC) profile
Since The Trane Company has a policy of continuous product and product data improvement, it reserves the right to change design and specifications without notice.