ZEC510 VAV Controllers

Installation Instructions

LC-ZEC510-x

Part No. 24-10143-01485, Rev. A
Issued October 2018

Refer to the QuickLIT website for the most up-to-date version of this document.

Applications

The ZEC510 VAV controller is a component of the Verasys® SMART Equipment™ family. The ZEC510 variable air volume (VAV) controller runs a pre-engineered HVAC zoning sequence and provides the inputs and outputs you require for VAV applications.

The ZEC510 controller has an optional occupancy feature that makes it possible for the controller to switch from occupied mode to standby mode based on zone activity. Standby mode maximizes energy savings by using setpoints that are higher and lower than occupied mode setpoints.

The ZEC510 controller uses plug and play technology to detect which network sensor types are connected. See the *Operation* section to determine the availability of additional sensor product information.

Use the Verasys Smart Building Hub (SBH) to configure the ZEC510 controller. Use the SBH or the VAV Balancing Thermostat to commission the controller.

IMPORTANT: Use this ZEC510 VAV controller only as an operating control. Where failure or malfunction of the ZEC510 controller could lead to personal injury or property damage to the controlled equipment or other property, additional precautions must be designed into the control system. Incorporate and maintain other devices, such as supervisory or alarm systems or safety or limit controls, intended to warn of or protect against failure or malfunction of the ZEC510 VAV controller.

IMPORTANT: Utiliser ce ZEC510 VAV controller uniquement en tant que dispositif de contrôle de fonctionnement. Lorsqu'une défaillance ou un dysfonctionnement du controller risque de provoquer des blessures ou d'endommager l'équipement contrôlé ou un autre équipement, la conception du système de contrôle doit intégrer des dispositifs de protection supplémentaires. Veiller dans ce cas à intégrer de façon permanente d'autres dispositifs, tels que des systèmes de supervision ou d'alarme, ou des dispositifs de sécurité ou de limitation, ayant une fonction d'avertissement ou de protection en cas de défaillance ou de dysfonctionnement du ZEC510 VAV controller.

North American Emissions Compliance

United States

This equipment has been tested and found to comply with the limits for a Class A digital device pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when this equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area may cause harmful interference, in which case users will be required to correct the interference at their own expense.

Canada

This Class (A) digital apparatus meets all the requirements of the Canadian Interference-Causing Equipment Regulations.

Cet appareil numérique de la Classe (A) respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

Installation

Follow these guidelines when you install a ZEC510 controller:

- Transport the ZEC510 controller in the original container to minimize vibration and shock damage.
- Do not drop the ZEC510 controller or subject it to physical shock.

Parts included

- One ZEC510 VAV Controller with removable system and zone buses, and power terminal blocks
- One self-drilling No. 10 mm x 25 mm (1 in.) screw

Materials and special tools needed

- 6 mm (1/4 in.) female spade terminals for input and output wiring and crimping tool or spade mounted terminal blocks
- A small straight-blade screwdriver for securing wires in the terminal blocks
- An 8 mm (5/16 in.) wrench or a 10 mm (3/8 in.) 12-point socket to tighten the square coupler bolt
- Shims or washers to mount the ZEC510 if necessary
- A power screwdriver
- A 100 mm (4 in.) extension socket or a punch
- A drill
- 3.5 mm (9/64 in.) drill bits
- A pliers to open and close the damper
- 3.97 mm (5/32 in.) ID poly tubing

Mounting

Safety guidelines

Follow these safety guidelines before mounting the controller:

IMPORTANT: When the air supply to the VAV box is below 10°C (50°F), make sure that any condensation on the VAV box, particularly on the damper shaft, does not enter the ZEC510 electronics. Mount the ZEC510 vertically above the damper shaft so that any shaft condensation falls away from the ZEC510. Additional measures may be required in some installations.

- Ensure that the mounting surface can support the ZEC510 and any user-supplied enclosure.
- Mount the ZEC510 on a hard, even surface.
- Use shims or washers to mount the ZEC510 securely and evenly on the mounting surface if necessary.
- Mount the ZEC510 in an area free of corrosive vapors that matches the ambient conditions specified in the *Technical specifications* section.
- Provide at least 50 mm (2 in.) on the top, bottom, sides, and front of the controller for cable and wire connections and adequate ventilation through the controller.
- Do not mount the ZEC510 in areas where electromagnetic emissions from other devices or wiring can interfere with controller communication.
- Avoid mounting the ZEC510 on surfaces with excessive vibration.
- Wear the appropriate personal protective equipment (PPE). For example, a hard hat, safety glasses, steel toe boots, and gloves.

Follow these additional guidelines when mounting the ZEC510 in a panel or enclosure:

- Do not install the ZEC510 in an airtight enclosure.
- Mount the ZEC510 so that the enclosure walls do not obstruct cover removal or ventilation through the controller.
- Mount the ZEC510 so that the power transformer and other devices do not radiate excessive heat to the controller.

Mounting the ZEC510

To mount the controller, complete the following steps:

1. Disconnect power from the controller transformer, the VAV box fan, and heater circuits if applicable.
2. Set all the switches on the field controller to their known settings. See *Setup and adjustments*.
3. Set the MS/TP address. See *Setup and adjustments*.
4. Ensure that the end of line (EOL) switch is set to the off position.
5. Use the zone bus address range 4-127 for Verasys zone bus controllers.
6. Place the ZEC510 on the actuator shaft so that the wiring connections are easily accessible.
7. Ensure that the ZEC510 base is parallel to the VAV box, perpendicular to the damper shaft. If necessary, use a spacer to offset tipping of the ZEC510 caused by the shaft bushings.

Note: Use the alignment marks to center the captive spacer to ensure sufficient movement in either direction.

Figure 1: Captive spacer alignment marks

8. Secure the self-drilling no.10 screw through the captive spacer with a power screwdriver and 100 mm (4 in.) extension socket. Alternatively, use a punch to mark the position of the shoulder washer.
9. Drill a hole into the VAV box using a 5/16 in. drill bit.
10. Insert the mounting screw and tighten it against the spacer.

IMPORTANT: Do not over-tighten the screw. Over-tightening can cause the threads to strip. If you mount the ZEC to the VAV box, make sure that the screws do not interfere with damper blade movement.

11. Locate the damper position using the marking on the end of the damper shaft.
12. Note the direction, clockwise (CW) or counterclockwise (CCW), required to close the damper. The actuator configuration depends on the amount of rotation necessary for the damper to go from the full-open to the full-closed position. Decide between the following options:
    - For 90° rotation, install the damper in the full-closed position.
    - For 45° or 60° rotation, install the damper in the full-open position.
13. Push down and hold the manual override button and turn the actuator coupler until it contacts the mechanical end-stop at either the full-closed or full-open position

Figure 2: Manual override and actuator coupler

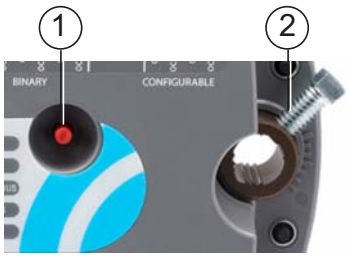


Table 1: Manual override and actuator coupler

1	Manual override button
2	Actuator coupler

14. If the damper for a 45° or 60° box closes CCW or CW, rotate the coupler to the CW mechanical limit. This action sets the open end-stop; the closed end-stop is set by the closed damper. For 45° and 60° boxes, you must provide hard stops at both full-closed and full-open damper positions. If you install the ZEC510 at the full-open position, it provides the open stop for 45° and 60° boxes. The closed damper seal provides the full-closed stop.
15. Tighten the square coupler bolt to the shaft using an 8 mm (5/16 in.) wrench or 10 mm (3/8 in.) 12-point socket. Tighten to 10.5 N·m to 11.5 N·m (95 lb·in to 105 lb·in).
16. Put a loop in the poly tubing to trap condensation when you attach the poly tubing to the ZEC510 pressure transducer ports. Loop the poly tubing before you make the final connections.
17. Push the manual override button, and turn the actuator coupling manually to ensure that the actuator can rotate from the full-closed to the full-open positions without binding.
18. Rotate the damper to the full-open position.

Wiring

⚠ WARNING

Risk of Electric Shock.
Disconnect power from the controller before making any adjustments. Do not touch any part of the printed circuit board while power is applied. Failure to follow these precautions can result in personal injury or death.

⚠ ADVERTISSEMENT

Risque de décharge électrique.
Déconnecter l'alimentation du controller avant toute opération de réglage. Veiller à ne toucher aucune partie du circuit imprimé lorsque celui-ci est sous tension. Le non-respect de ces précautions peut provoquer des blessures graves, voire mortelles.

IMPORTANT: Do not exceed the controller electrical ratings. Exceeding controller electrical ratings can result in permanent damage to the controller and void any warranty.

IMPORTANT: Do not connect supply power to the controller before finishing wiring and checking all wiring connections. Short circuits or improperly connected wires can result in damage to the controller and void any warranty.

IMPORTANT: Use copper conductors only. Make all wiring in accordance with local, national, and regional regulations.

To wire the ZEC510, complete the following steps:

1. Use the appropriate figures according to your particular configuration:
   - Figure 9 and Figure 10 if you are using staged outputs for the heating control
   - Figure 11 and Figure 12 if you are using incremental outputs for the heating control
   - Figure 14 and Figure 15 if you are using proportional outputs for the heating control
2. Wire the network temperature sensor and CO_2 sensor to the sensor bus on the ZEC510. See *Sensor bus terminal block*.

   Note: The CO_2 sensors require a 24 VAC power supply in addition to wiring the **+**, **-**, **COM**, and **SA PWR** terminals. For more information, refer to the *NS Series CO_2 Network Sensors Installation Instructions (Part No. 24-10424-6)*.
3. Wire the zone bus in a daisy-chain configuration. See *Zone bus terminal block*.
4. Set the device address DIP switch to the appropriate address. See *Setting the ZEC510 device address*.
5. If the ZEC510 is at the end or beginning of the line, set the EOL switch to the **ON** position.
6. Connect the ZEC510 to 24 VAC, Class 2 power.

Input and output terminals

Sensor bus terminal block

The sensor bus terminal block is a brown, removable, 4-terminal plug that fits only into the brown, board-mounted sensor bus jack. Wire the removable sensor bus terminal block plugs on the ZEC510 and other field devices in a daisy-chain configuration using 4-wire twisted, shielded cable as shown in Figure 3 and Figure 4.

Figure 3: Sensor bus terminal block wiring

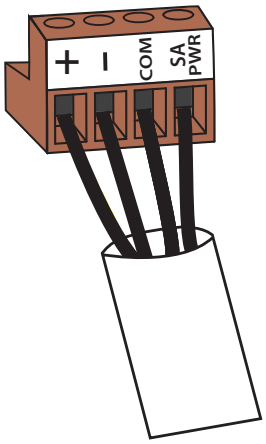


Figure 4: Sensor bus daisy chaining configuration

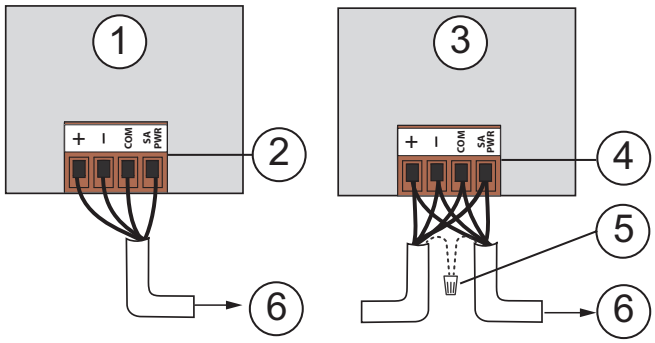


Table 1: Sensor bus daisy chaining configuration

1	Terminating device on the sensor bus
2	Sensor bus terminal block plug on the terminating device
3	Daisy-chained device on a sensor bus segment
4	Sensor bus terminal block plug on the daisy-chained device
5	Cable shield connection
6	Connects to the next device on the sensor bus. Connects to the NS-xxxx sensors. See the *Accessories* section for a list of the NS-xxxx sensors.

Zone bus terminal block

The zone bus terminal block is a gray, removable, 4-terminal plug that fits only into the black, board-mounted, zone bus jack. Wire the removable zone bus terminal block plugs on the ZEC510 and other zone bus controllers in a daisy-chain configuration using 3-wire twisted, shielded cable, as shown in Figure 5 and Figure 6.

Figure 5: Zone bus terminal block wiring

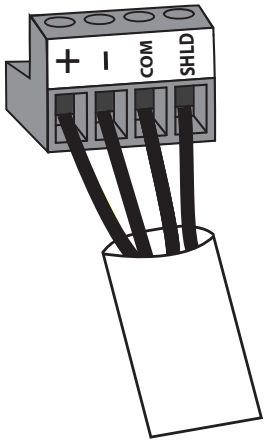


Figure 6: Zone bus daisy chaining configuration

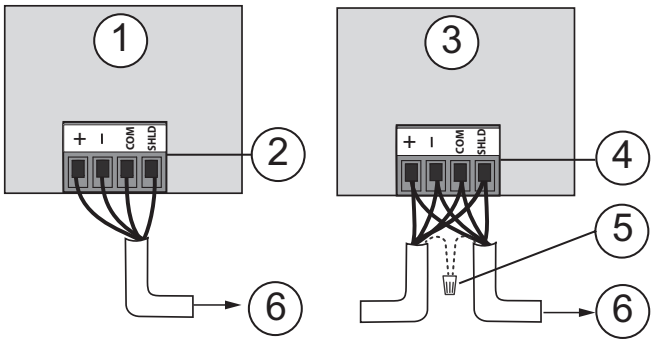


Table 2: Zone bus daisy chaining configuration

1	Terminating device on the zone bus
2	Zone bus terminal block plug on the terminating device
3	Daisy-chained device on a zone bus segment
4	Zone bus terminal block plug on the daisy-chained device
5	Cable shield connection
6	Connects to the next device on the zone bus. Connects to all ZECs and the zoning roof top unit (RTU) of the VZC100.

Modular ports

The modular sensor and zone bus ports on the front of the ZEC510 are RJ12, six-position, modular jacks. The modular sensor bus ports provide a connection for the VAV Balancing Tool. The zone bus port is not used in ZEC510 installations. The following figure shows the pin number assignments on the modular port.

Figure 7: Pin number assignments

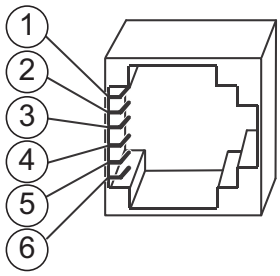


Table 3: Pin number assignments

1	Power 15 VDC
2	Bus and power common
3	Power 15 VDC
4	Bus and power common
5	Sensor or zone bus **-**
6	Sensor or zone bus **+**

Supply power terminal block

The 24 VAC supply power terminal block is a gray, removable, 2-terminal plug that fits into a board-mounted jack on the upper left of the ZEC controller. Wire the 24 VAC supply power wires from the transformer to the **HOT** and **COM** terminals on the terminal plug as shown in the following figure.

Figure 8: VAC Supply power terminal block wiring

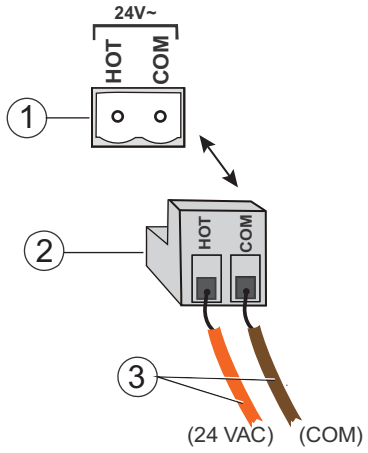


Table 4: VAC Supply power terminal block wiring

1	Supply power terminal block jack
2	Supply power terminal block plug
4	Wires from Johnson Controls 90 VAC to 24 VAC, Class 2, power transformer

IMPORTANT: Do not share the 24 VAC power with other network devices. Sharing power with other network devices can cause noise, interference, and ground loop problems. You may damage the controller by sharing power with other devices.

Wiring diagrams

Object names

Use the following list to understand the names of the outputs in the following wiring diagrams. The expanded descriptions appear in the Verasys user interface.

Table 5: Object names and expanded descriptions

Object name	Expanded description
HTG-C	**HEATING STAGE COMMAND**
HTG1-C	**HEATING STAGE COMMAND 1**
HTG2-C	**HEATING STAGE COMMAND 2**
HTG3-C	**HEATING STAGE COMMAND 3**
SUPHTG1-C	**SUPPLEMENTAL HEATING STAGE COMMAND**
SUPHTG-O	**SUPPLEMENTAL HEATING PERCENT COMMAND**
HTG-O	**HEATING PERCENT COMMAND**
ZN-CO2	**ZONE AIR QUALITY** or **ZONE CO2**
ZN-T	**ZONE TEMPERATURE**
OCC-S	**OCCUPANCY STATUS**
SF-C	**SUPPLY FAN COMMAND**
DA-T	**DISCHARGE AIR TEMPERATURE**

ZEC510-1 controller - VAV with staged reheat control wiring example

Figure 9: ZEC510-1 - flow diagrams

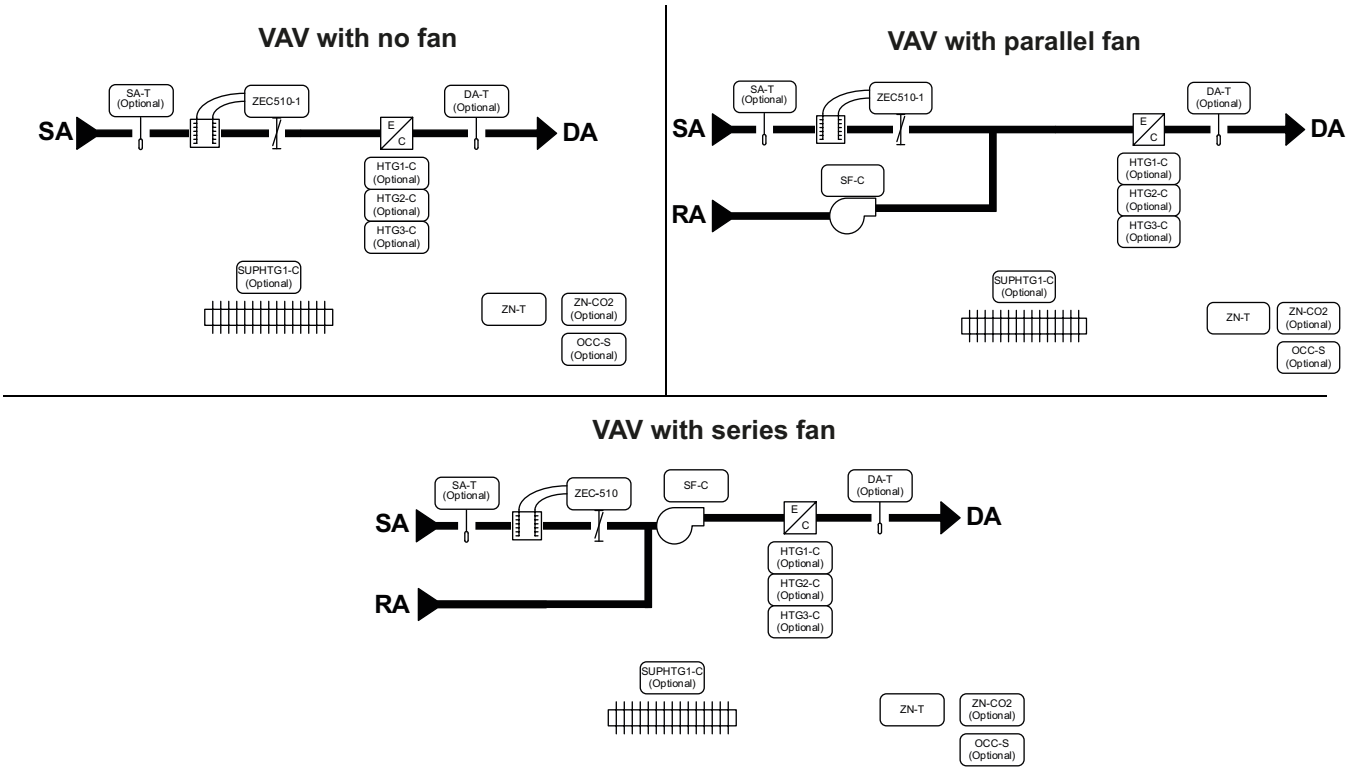


Figure 10: ZEC510-1 - controller wiring diagram

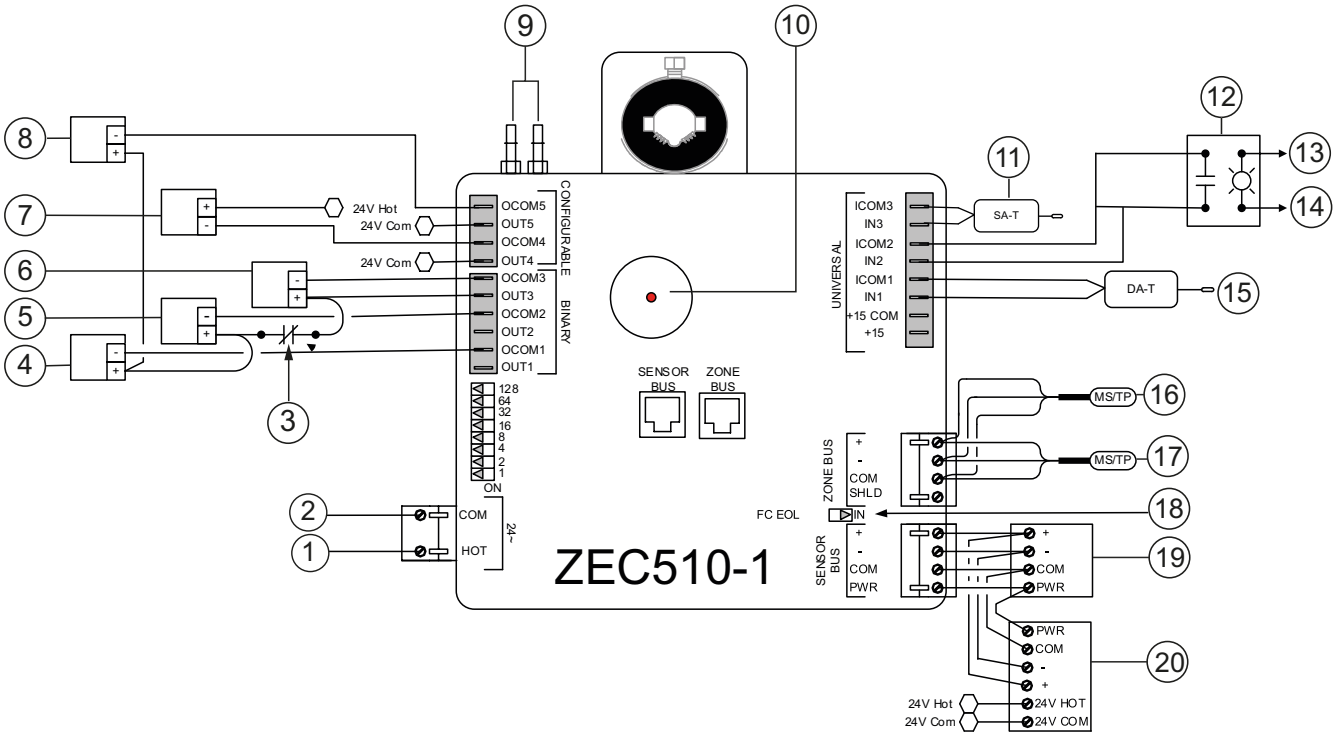


Table 6: ZEC510-1 - controller wiring diagram

Number	Description	Object name
1	24 V HOT power transformer	n/a
2	24 V COM power transformer	n/a
3	Electric heat safeties	n/a
4	Optional. Heating stage command 1	HTG1-C
5	Optional. Heating stage command 2	HTG2-C
6	Optional. Supply fan command	SF-C
7	Optional. Supplemental heating stage command	SUPHTG1-C
8	Optional. Heating stage command 3	HTG3-C
9	Pressure ports. No polarity	n/a
10	Manual override	n/a
11	Optional. Supply air temperature	SA-T
12	Optional. Relay: RIBU1C	n/a
13	Occupancy sensor OLS-2100-1. To red wire occupancy switch	n/a
14	Occupancy sensor OLS-2100-1. To neutral occupancy switch	n/a
15	Optional. Discharge air temperature	DA-T
16	To next device	n/a
17	From last device	n/a
18	See riser schedule to determine the EOL device. You must set the EOL switch to the **ON** position on the EOL device.	n/a
19	Zone temperature sensor. The connector is located on the back of the sensor.	ZN-T
20	Optional. Zone CO_2 sensor. The connector is located on the back of the sensor.	ZN-CO2

Note: Heating or fan contactors are in the VAV box. The VAV controller binary outputs switch the common OUT1, OUT2, and OUT3 are 24 V HOT continuously.

Note: You can average up to five NS sensors. Connect the NS sensors in a daisy-chain configuration using the addresses in the *Configuring the NS sensors* section. The fifth sensor must have the fixed address 199.

Note: If you install CO_2 Net sensors, in addition to the 24 VAC power for the controller, you must also supply 24 VAC power to the **HOT** and **COM** terminals.

ZEC510-2 controller - VAV with incremental reheat control wiring example

Figure 11: ZEC510-2 - flow diagrams

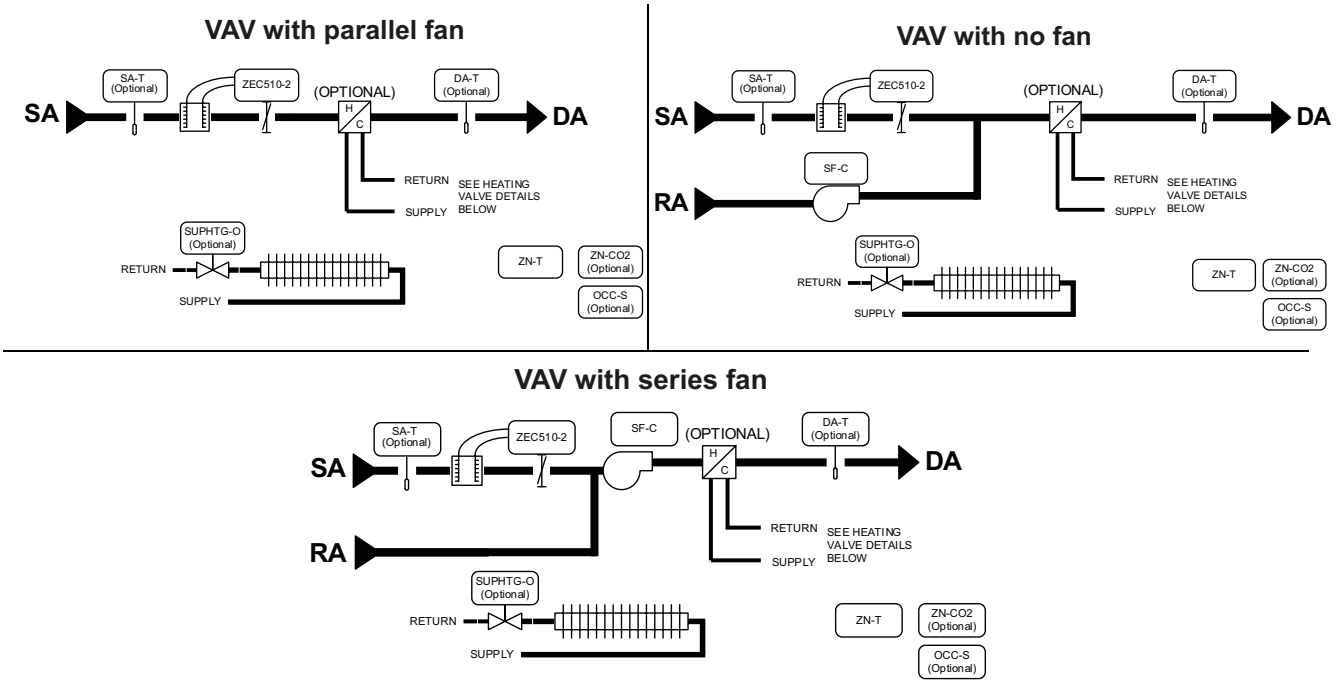


Figure 12: ZEC510-2 - wiring diagram

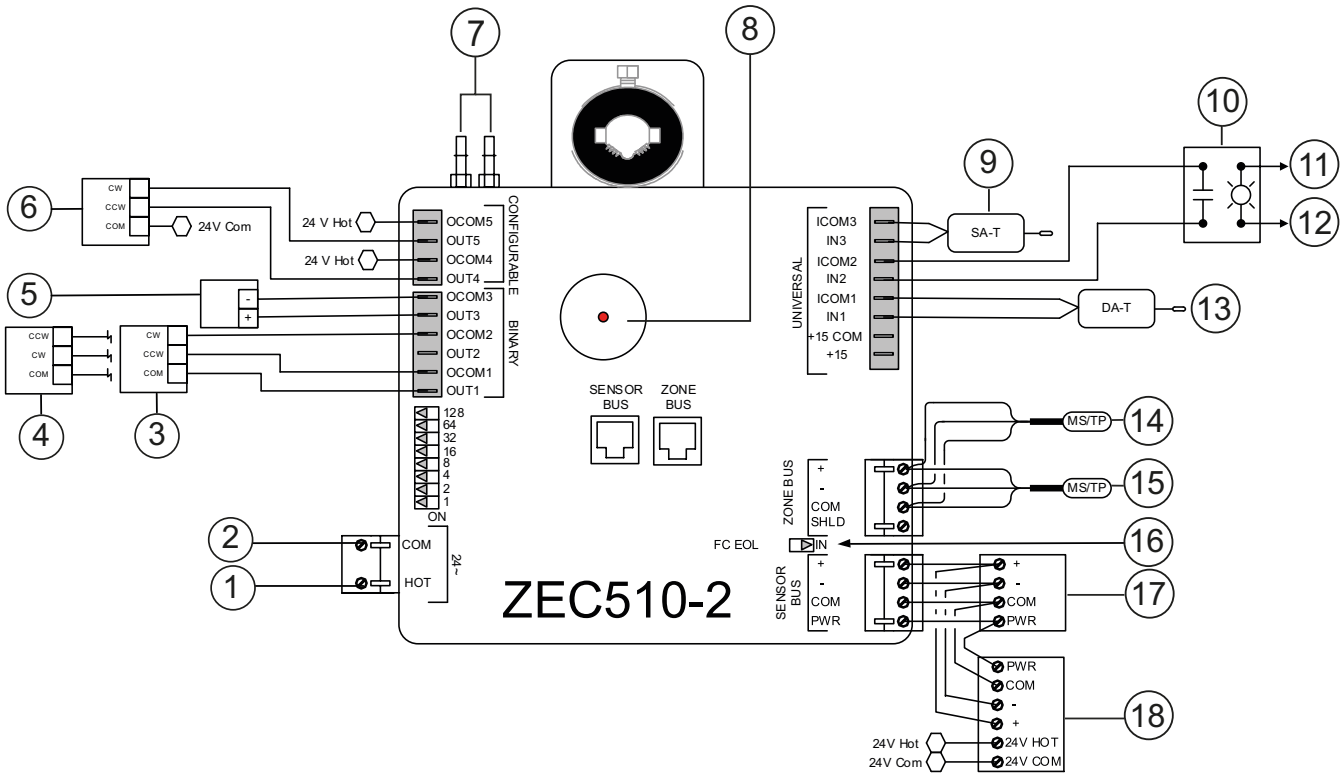


Table 7: ZEC510-2 wiring diagram

Number	Description	Object name
1	24 V HOT power transformer	n/a
2	24 V COM power transformer	n/a
3	Optional. Heating percent command Terminations for 2-way or 3-way coil - A valve configurations. CCW to open	HTG-O
4	Optional. Heating percent command Terminations for 3-way coil - B valve configuration. CCW to close	HTG-O
5	Optional. Supply fan command	SF-C
6	Optional. Supplemental heating percent command. CCW to open	SUPHTG-O
7	Pressure ports. No polarity	n/a
8	Manual override	n/a
9	Optional. Supply air temperature	SA-T
10	Optional. Relay: RIBU1C	n/a
11	To red wire occupancy switch	n/a
12	To neutral occupancy switch	n/a
13	Optional. Discharge air temperature	DA-T
14	To next device	n/a
15	From last device	n/a
16	See riser schedule to determine the EOL device. You must set the EOL switch to the **ON** position on the EOL device.	n/a
17	Zone temperature sensor. The connector is located on the back of the sensor.	ZN-T
18	Optional. Zone CO_2 sensor. The connector is located on the back of the sensor.	ZN-CO2

Note: Both heating valves default to the 60-second incremental actuator factory default value. You can adjust this in Verasys.

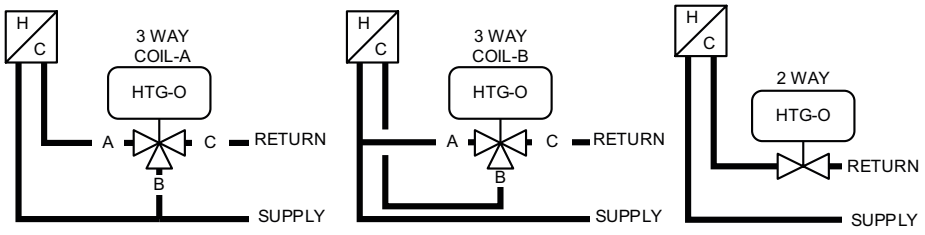
Note: You can average up to five NS sensors. Connect the NS sensors in a daisy-chain configuration using the addresses in the *Configuring the NS sensors* section. The fifth sensor must have the fixed address 199.

Note: If you install CO_2 Net sensors, in addition to the 24 VAC power for the controller, you must also supply 24 VAC power the **HOT** and **COM** terminals.

Piping details for valve configurations

See the valve schedule for the specific configuration.

Figure 13: Piping details



ZEC510-3 controller - Multizone unit VAV with proportional reheat control wiring example

Figure 14: ZEC510-3 - Flow diagrams

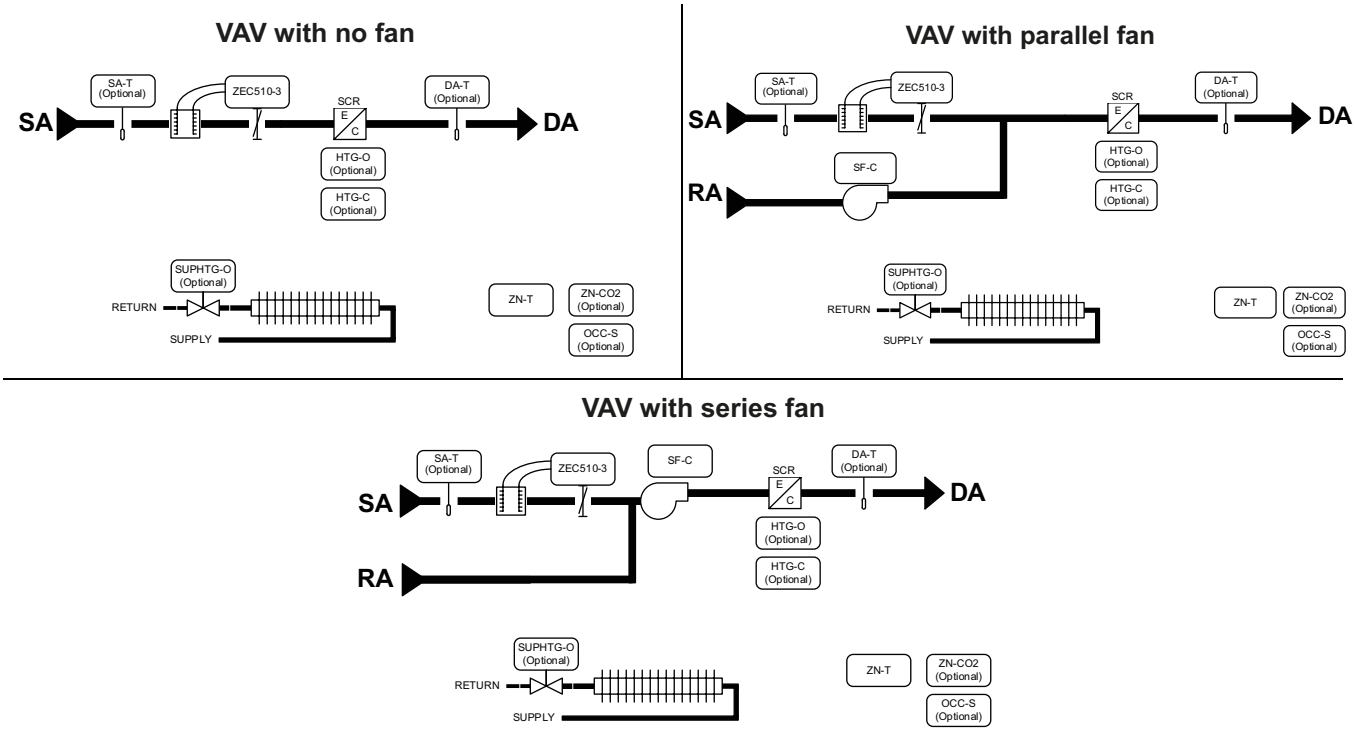


Figure 15: ZEC510-3 - Wiring diagram

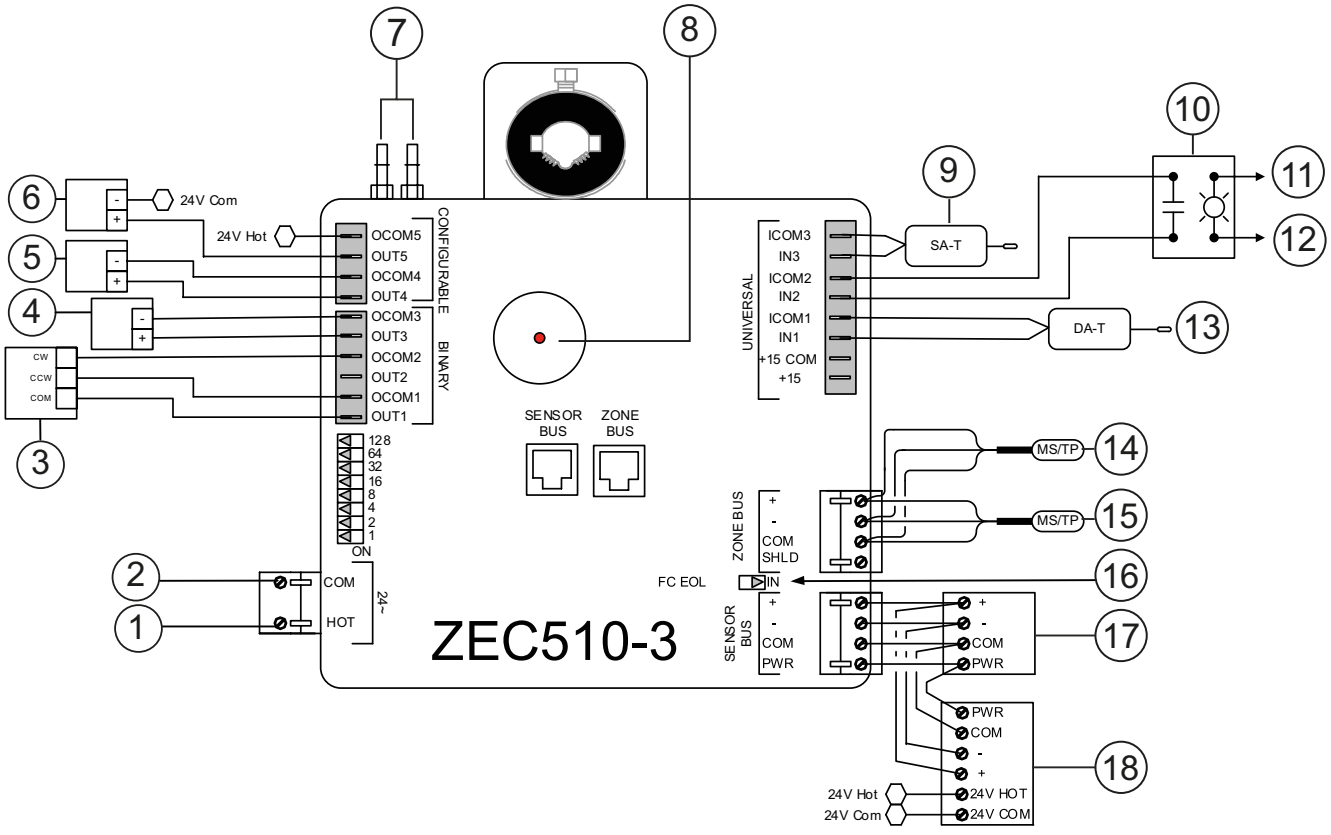


Table 8: ZEC510-3 - Wiring diagram

Number	Description	Object name
1	24 V HOT power transformer	n/a
2	24 V COM power transformer	n/a
3	Optional. Supplemental heating percent command.	SUPHTG-O
4	Optional. Supply fan command	SF-C
5	Optional. Heating percent command	HTG-O
6	Optional. Heating stage command	HTG-C
7	Pressure ports. No polarity	n/a
8	Manual override	n/a
9	Optional. Supply air temperature	SA-T
10	Optional. Relay: RIBU1C	n/a
11	To red wire occupancy switch	n/a
12	To neutral occupancy switch	n/a
13	Optional. Discharge air temp	DA-T
14	To next device	n/a
15	From last device	n/a
16	See riser schedule to determine the EOL device. You must set the EOL switch to the **ON** position on the EOL device.	n/a
17	Zone temperature sensor. The connector is located on the back of the sensor.	ZN-T
18	Optional. Zone CO_2 sensor. The connector is located on the back of the sensor.	ZN-CO2

Notes:

- Figure 15 shows a connection to an electric SCR reheat coil that is proportionally controlled. You can use the same heating percent command signal, which is 0 V to 10 V, to control either an SCR reheat coil, or a proportional water valve, depending on what is present.
- Supplemental valves default to the 60-second incremental actuator factory default value. You can adjust this in Verasys.
- You can average up to five NS sensors. Connect the NS sensors in a daisy-chain configuration using the addresses in the *Configuring the NS sensors* section. The fifth sensor must have the fixed address 199.
- If you install CO_2 Net sensors, in addition to the 24 VAC power for the controller, you must also supply 24 VAC power the **HOT** and **COM** terminals.

Sequence of operation

Occupied mode:

- When the zone temperature is between the occupied heating and cooling setpoints inside of the bias, the primary air damper is at the minimum cubic feet per minute (cfm) and no mechanical heating runs.
- When the zone temperature rises above the cooling setpoint, the primary air damper increases the cfm and no mechanical heating runs.
- When the zone temperature falls below the heating setpoint, the system uses supplemental heating first, then box heating. The damper remains at a minimum cfm setpoint during the heating period.

Note: One exception to the above staging procedure is if the ZEC510 controls hot water valves and the **Control Application Type** is set to **Incremental** the system assumes that there is an incremental water valve and you can set **Dual Max Enable** to **Enable**. This option can provide tighter control of air exiting the box.

Note: The box reheat and supplemental reheat are a box option. You have a cooling only box if you do not choose either reheat or supplemental reheat.

Unoccupied mode:

- When the zone temperature is between the unoccupied heating and cooling setpoints inside of the bias, the primary air damper is at the minimum cfm, and no mechanical heating runs.
- When the zone temperature rises above the unoccupied cooling setpoint, the primary air damper increases the cfm, and no mechanical heating runs.
- When the zone temperature falls below the unoccupied heating setpoint, the supplemental heating coil is fully used before the reheat heat coil engages. The damper is at the minimum cfm.

Unit enable

A network unit **Enable** signal controls the mode of the box. If you set the signal to **Disable**, all outputs for that box are disabled.

Fan control (optional): A parallel fan cycles on when a request for heating occurs. The fan remains off in all other cases. Series fans run continuously in occupied mode. The fan moves from unoccupied mode to cycle on mode when it receives a request for heating or cooling.

Occupancy lighting switch (optional):

- You can add an occupancy lighting switch to the box to temporarily set the VAV box to standby when mode it does not detect occupancy. When the box detects occupancy, the zone switches back to occupied mode.
- Standby mode uses standby heating and cooling setpoints that are slightly higher and lower than the occupied cooling and heating setpoints, respectively. The VAV box also uses unoccupied flow setpoints.

Demand control ventilation (optional):

- You can proportionally reset the minimum damper flows based on an air quality setpoint when you wire the zone CO_2 sensors to the boxes to detect the air quality in the zone.
- The reset of the damper minimum flows do not exceed the maximum value that you set. The CO_2 sensor with the highest value determines the reset when you wire more than one CO_2 sensor to the boxes.

Configuring the NS sensors

Use the following diagrams and tables to address the NS sensors.

Figure 16: CO_2 net stat with terminals addressable

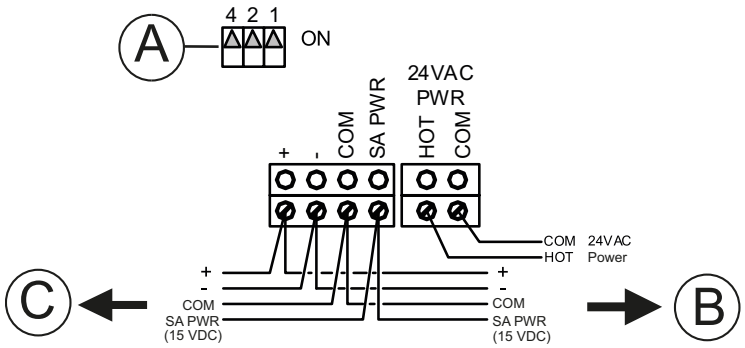


Table 9: CO_2 NS sensors with terminals addressable

A	Address switch
B	To next device on the sensor bus if required
C	From previous device on the sensor bus

Table 10: CO_2 NS sensor addresses

Available DIP switch addresses	DIP switch settings		
	Switch 4	**Switch 2**	**Switch 1**
212	Off (open)	Off (open)	Off (open)
213	Off (open)	Off (open)	On (closed)
214	Off (open)	On (closed)	Off (open)
215	Off (open)	On (closed)	On (closed)
216	On (closed)	Off (open)	Off (open)
217	On (closed)	Off (open)	On (closed)
218	On (closed)	On (closed)	Off (open)
219	On (closed)	On (closed)	On (closed)

Figure 17: NS sensors with terminals addressable

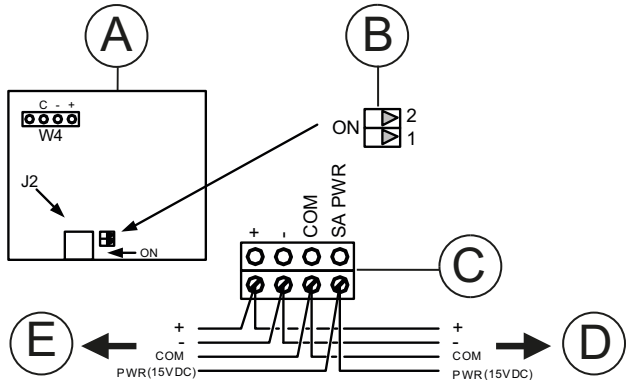


Table 11: NS sensors with terminals addressable

A	Thermostat circuit board **Note:** Jack J2 is for commissioning tools.
B	Address switch
C	Terminal block on the NS sensor. Connector on the mounting base slides into W4 pins on the circuit board
D	To next device on the sensor bus if required
E	From previous device the on the sensor bus

Table 12: NS sensor addresses

SW1	SW2	Address
OFF	OFF	200
ON	OFF	201
OFF	ON	202
ON	ON	203

ZEC510 terminal functions, ratings, requirements, and wiring guidelines

Input and output wiring guidelines

Use the following guidelines to wire the ZEC510 inputs and outputs. See Table 13 for more information about the functions, ratings, and requirements for the ZEC510 input and output terminals.

- Run all low-voltage and high-voltage cables and wiring separately.
- Use twisted, insulated, and stranded copper wires for input and output cables.
- If the input or output cables are exposed to high electromagnetic or radio frequency noise, use shielded cable.

System and zone bus supply power wiring guidelines

Use the following guidelines to wire the system and zone buses and the supply power. See Table 13 for more information about the functions, ratings, and requirements for the ZEC510 input and output terminals.

- Run all low-voltage and high-voltage cables and wiring separately.
- Use twisted, insulated, and stranded copper wires for all system and zone bus cables.
- Use shielded cables for all system and zone bus cables.
- Refer to the *MS/TP Communications Bus Technical Bulletin (LIT-12011670)* for detailed information about wire size and cable length requirements for the zone bus.

Wire gauges and lengths

Table 13: ZEC510 wiring details (Part 1 of 4)

Terminal	Terminal labels	Function and electrical ratings and requirements	Cable type and length
Analog Input (AI)	**IN1**	Provides an AI connection for discharge air (DA-T) sensor.	0.6 mm (22 AWG) stranded, 2-wire twisted cable for runs of <30 m (<90 ft).
	IN2	Provides a BI connection for occupancy sensor dry contact (optional).	n/a
	IN3	Provides an AI connection for supply air (SA-T) sensor.	0.6 mm (22 AWG) stranded, 2-wire twisted cable for runs of <30 m (<90 ft).
Binary Output (BO) for VAV with staged reheat control	**OUT1**	Provides a BO connection for box heating stage 1. Internal power source: 24 VAC power, **24~ HOT.**	See guideline C in Table 14
	OCOM1	Provides a BO connection for box heating stage 1. Connects **OCOM1** to **24~ COM** when activated. Internal power source: 30 VAC maximum voltage to load, 0.5 A maximum output current, 40 mA minimum load current.	See guideline C in Table 14
	OUT2	Provides a BO connection for box heating stage 2. Internally sources 24 VAC power, **24~ HOT.**	See guideline C in Table 14
	OCOM2	Provides a BO connection for box heating stage 2. Connects **OCOM2** to **24~ COM** when activated. Internal power source: 30 VAC maximum voltage to load, 0.5 A maximum output current, 40 mA minimum load current.	See guideline C in Table 14
	OUT3	Provides a BO connection for box fan. Internal power source: 24 VAC power, **24~ HOT.**	See guideline C in Table 14
	OCOM3	Provides a BO connection for box fan. Connects **OCOM3** to **24~ COM** when activated. Internal power source: 30 VAC maximum voltage to load, 0.5 A maximum output current, 40 mA minimum load current.	See guideline C in Table 14

Table 13: ZEC510 wiring details (Part 2 of 4)

Terminal	Terminal labels	Function and electrical ratings and requirements	Cable type and length
Binary Output (BO) for VAV with staged reheat control	**OUT4**	Provides a BO connection for supplemental heat. Connects **OUT4** to **OCOM4** when activated. **Note:** Requires external power source: 30 VAC maximum voltage to load, 0.5 A maximum output current, 40 mA minimum load current.	See guideline C in Table 14
	OCOM4	Provides a BO connection for supplemental heat. **Note:** This common is isolated from all other commons, so jumper **24~ COM** terminal if in use.	See guideline C in Table 14
	OUT5	Provides a BO connection for box heating stage 3. Connects **OUT5** to **OCOM5** when activated. **Note:** Requires external power source: 30 VAC maximum voltage to load, 0.5 A maximum output current, 40 mA minimum load current.	See guideline C in Table 14
	OCOM5	Provides a BO connection for box heating stage 3. **Note:** This common is isolated from all other commons, so jumper **24~ COM** terminal if in use.	See guideline C in Table 14
Binary Output (BO) for VAV with incremental reheat control	**OUT1**	**OUT1** and **OUT2** together provide a position adjust output for box heating. **OUT1** represents **Open** and **OUT2** represents **Close**. Internal power source: 24 VAC power, **24~ HOT.**	See guideline C in Table 14
	OCOM1	Provides a BO connection for box heating **Open**. Connects **OCOM1** to **24~ COM** when activated. Internal power source: 30 VAC maximum voltage to load, 0.5 A maximum output current, 40 mA minimum load current.	See guideline C in Table 14
	OUT2	**OUT1** and **OUT2** together provide a position adjust output for box heating. **OUT1** represents **Open** and **OUT2** represents **Close**. Internal power source: 24 VAC power, **24~ HOT**.	See guideline C in Table 14
	OCOM2	Provides a BO connection for Box Heating **Close**. Connects **OCOM2** to **24~ COM** when activated. Internal power source: 30 VAC maximum voltage to load, 0.5 A maximum output current, 40 mA minimum load current.	See guideline C in Table 14
	OUT3	Provides a BO connection for box fan. Internal power source: 24 VAC power, **24~ HOT**.	See guideline C in Table 14
	OCOM3	Provides a BO connection for box fan. Connects **OCOM3** to 24~ COM when activated. Internal power source: 30 VAC maximum voltage to load, 0.5 A maximum output current, 40 mA minimum load current.	See guideline C in Table 14
	OUT4	**OUT4** and **OUT5** together provide a position adjust output for supplemental heating. **OUT4** represents **Open** and **OUT5** represents **Close**. **Note:** Requires externally sourced 24 VAC power, **24~ HOT**, see Figure 12.	See guideline C in Table 14
	OCOM4	Provides a BO connection for supplemental heating **Open**. **Note:** This common is isolated from all other commons, so jumper **24~ COM** terminal if in use.	See guideline C in Table 14

Table 13: ZEC510 wiring details (Part 3 of 4)

Terminal	Terminal labels	Function and electrical ratings and requirements	Cable type and length
Binary Output (BO) for VAV with incremental reheat control	**OUT5**	**OUT4** and **OUT5** together provide a position adjust output for supplemental heating. **OUT4** represents **Open** and **OUT5** represents **Close**. Requires externally sourced 24 VAC power, **24~ HOT,** see Figure 12.	See guideline C in Table 14
	OCOM5	Provides a BO connection for supplemental heating **Close**. **Note:** This common is isolated from all other commons, so jumper **24~ COM** terminal if in use.	See guideline C in Table 14
Binary Output (BO) for Multizone unit VAV with proportional reheat control	**OUT1**	**OUT1** and **OUT2** together provide a position adjust output for supplemental heating. **OUT1** represents **Open** and **OUT2** represents **Close**. Internal power source: 24 VAC power, **24~ HOT.**	See guideline C in Table 14
	OCOM1	Provides a BO connection for supplemental heating **Open**. Connects **OCOM1** to **24~ COM** when activated. Internal power source: 30 VAC maximum voltage to load, 0.5 A maximum output current, 40 mA minimum load current.	See guideline C in Table 14
	OUT2	**OUT1** and **OUT2** together provide a position adjust output for supplemental heating. **OUT1** represents **Open** and **OUT2** represents **Close**. Internal power source: 24 VAC power, **24~ HOT.**	See guideline C in Table 14
	OCOM2	Provides a BO connection for supplemental heating **Close**. Connects **OCOM1** to **24~ COM** when activated. Internal power source: 30 VAC maximum voltage to load, 0.5 A maximum output current, 40 mA minimum load current.	See guideline C in Table 14
	OUT3	Provides a BO connection for box fan. Internal power source: 24 VAC power, **24~ HOT.**	See guideline C in Table 14
	OCOM3	Provides a BO connection for box fan. Connects **OCOM3** to **24~ COM** when activated. Internal power source: 30 VAC maximum voltage to load, 0.5 A maximum output current, 40 mA minimum load current.	See guideline C in Table 14
	OUT4	Provides an AO connection for box heat. Outputs 0 VDC to 10 VDC signal, 10mA maximum output current. Requires 1 k to 50 k ohm load.	See guideline A in Table 14
	OCOM4	Provides AO connection for box heat. **Note:** This common is isolated from all other commons.	See guideline A in Table 14
	OUT5	Provides a BO connection for box heating. Connects **OUT5** to **OCOM5** when activated. **Note:** Requires external power source: 30 VAC maximum voltage to load, 0.5 A maximum output current, 40 mA minimum load current.	See guideline C in Table 14
	OCOM5	Provides BO connection for box heat. **Note:** This common is isolated from all other commons, so jumper **24~ COM** terminal if in use.	See guideline C in Table 14

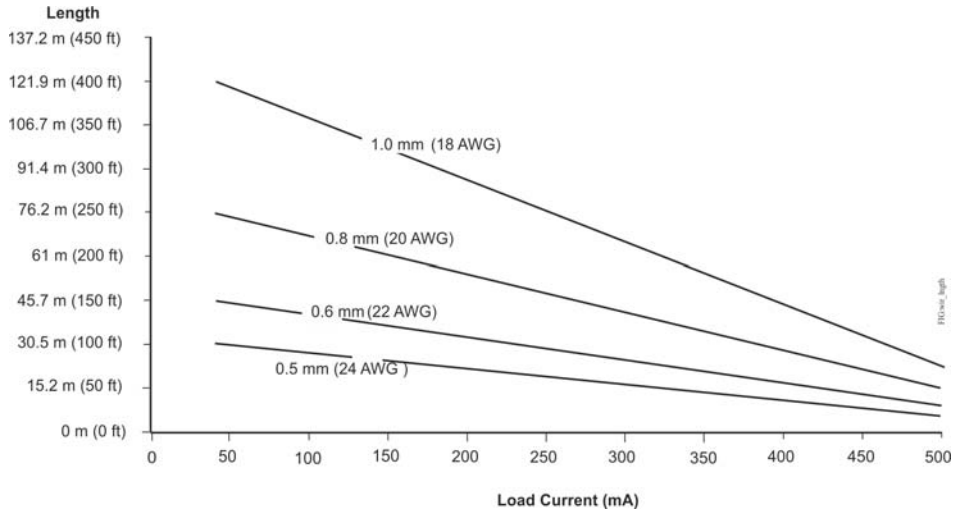
Table 13: ZEC510 wiring details (Part 4 of 4)

Terminal	Terminal labels	Function and electrical ratings and requirements	Cable type and length
Sensor (SA) bus terminal block	**+, -, COM, SA PWR**	Supplies 15 VDC power for SA bus devices. Supports five NS Series Network Zone Temperature Sensors and up to five NS Series Network CO_2 Sensors.	0.6 mm (22 AWG) stranded, 4-wire twisted cable for runs of <30 m (<99 ft)
Zone (FC) bus terminal block	**+, -, COM**	Provides communication network	0.65 mm (22 AWG) stranded, twisted shielded cable for runs of 1,000 ft maximum
24 VAC power	**HOT**	AC input supply 20 VAC to 30 VAC (nominal 24 VAC)	0.8 mm to 1.5 mm (20 AWG to 16 AWG) 2-wire
	COM	24 VAC power common	

Table 14: Cable length guidelines for wire sizes

Guideline	Wire size/guage and type	Maximum cable length and type	Assumptions
A	1.0 mm (18 AWG) stranded copper	457 m (1,500 ft) twisted wire	100 mV maximum voltage drop Depending on the cable length and the connected input or output device, you might have to define an offset in the setup software for the input or output point.
	0.8 mm(20 AWG) stranded copper 297 m (975 ft) twisted wire	297 m (975 ft) twisted wire	
	457 m (1,500 ft) twisted wire 183 m (600 ft) twisted wire	183 m (600 ft) twisted wire	
	0.5 mm (24 AWG) stranded copper 107 m (350 ft) twisted wire	107 m (350 ft) twisted wire	
B	1.0 mm (18 AWG) stranded copper	229 m (750 ft) twisted wire	100 mV maximum voltage drop Depending on the cable length and the connected input or output device, you might have to define an offset in the setup software for the input or output point.
	0.8 mm (20 AWG) stranded copper 297 m (975 ft) twisted wire	137 m (450 ft) twisted wire	
	0.6 mm (22 AWG) stranded copper 183 m (600 ft) twisted wire	91 m (300 ft) twisted wire	
	0.5 mm (24 AWG) stranded copper 107 m (350 ft) twisted wire	61 m (200 ft) twisted wire	
C	To select wire size and gauge, see Figure 18. Use stranded copper wire.	To determine cable length, see Figure 18. Use twisted wire cable.	n/a

Figure 18: Maximum wire length by current and wire size



Setup and adjustments

Setting the ZEC510 device address

Before you apply power or operate the ZEC510, you must set a valid and unique device address for the controller on the bus. Ensure that your system meets the following prerequisite configuration and complete the addressing steps.

Prerequisites

- Identify the addresses when you design the system before the installation so that the rest of the devices on the bus do not conflict with the address you select for the ZEC510.
- Set a unique and sequential device address for each of the field controllers connected on the system bus or zone bus, starting with device address 4. To ensure the best bus performance, set sequential device addresses with no gaps in the device address range (4, 5, 6, and so on). The controllers do not need to be physically connected on the bus in their numerical device address order.

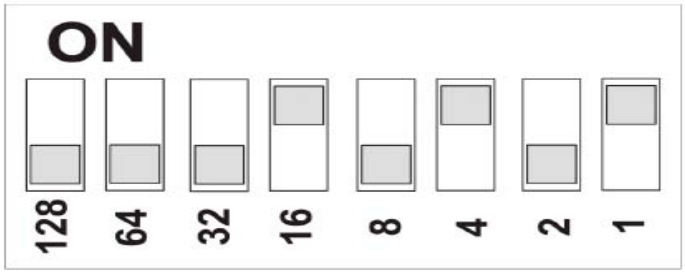
Note: The ZEC510 uses a single 8-way DIP switch to set the address. The switch is binary weighted, so you can set addresses from 4 to 127. The DIP switch block has eight switches numbered **128**, **64**, **32**, **16**, **8**, **4**, **2**, and **1**. Calculate the address number by adding the values of the switches set to **ON.** The sum of the switches in the **ON** position equals the address. For example, if switches 1, 4, and 16 are set to **ON**, 1 + 4 + 16 = address 21. See Figure 19.

To set the device addresses on the ZEC510, complete the following steps:

1. Set all of the switches to the off position on the DIP switch block.
2. Set the highest number switch that is less than or equal to the intended device address to **ON**.
3. Continue setting lower numbered switches until the total equals the intended address.
4. Write each field controller's device address on the white label below the DIP switch block on the cover of the controller.

Refer to the *MS/TP Communications Bus Technical Bulletin (LIT-12011034)* for more information on field controller device addresses and how to set them on MS/TP bus devices.

Figure 19: Setting the device address on the DIP switch block



Accessories

Table 15: Accessories

Product Code Number	Description
Zone CO_2 sensor	
NS-BCN7004-0	BACnet network CO_2 sensor designed to function directly with Johnson Controls BACnet MS/TP digital controllers, in an 80 mm x 120 mm (3 in. x 4.5 in.) enclosure with terminal block and modular jack wiring connections. Only addresses 212 to 214 are supported.
Zone Temperature sensors (NS sensors)	
NS-BTB7003-0	Network sensor, 120 mm x 80 mm (4.7 in. x 3.1 in.), Johnson Controls® logo, local setpoint, terminals
NS-BTB7003-2	Network sensor, 120 mm x 80 mm (4.7 in. x 3.1 in.), no logo, local setpoint, terminals
NS-BTN7003-0	Network sensor, 120 mm x 80 mm (4.7 x 3.1 in.), no logo, no setpoint, terminals
NS-BTN7003-2	Network sensor, 120 mm x 80 mm (4.7 in. x 3.1 in.), no logo, no setpoint, terminals
NS-BTP7002-0	Network sensor, 120 mm x 80 mm (4.7 in. x 3.1 in.), Johnson Controls logo, warmer/cooler adjustment, terminals
NS-BTP7002-2	Network sensor, 120 mm x 80 mm (4.7 in. x 3.1 in.), no logo, warmer/cooler adjustment, terminals
Occupancy lighting switch	
NS-BCN7004	Occupancy-sensing light switch for control of indoor incandescent and fluorescent lights
RIBU1C	Enclosed relay for OLS-2100-1 sensor
Balancing tool	
NS-ATV7003-0	Handheld VAV balancing tool

Troubleshooting

Use the following information to troubleshoot the ZEC510 controller.

Status LEDs

The following table provides a description of the LED modes.

Table 16: ZEC510 status LEDs

LED label	LED color	Normal state	Description of LED states
POWER	Green	Steady on	Off steady = The controller has no power On steady = Operating normally, and primary voltage powers the controller
FAULT	Red	Steady off	Blink - 2 Hz = Download or startup is in progress. The controller is not ready for normal operation. Sensor bus devices are offline. Rapid blink = Sensor bus communications problem Off steady = No faults On steady = Device fault or no application loaded
SA BUS (sensor bus)	Green	Blink - 2 Hz	Blink - 2 Hz = Data transmission. Normal communication Off steady = No data transmission. Auto baud in progress On steady = Communication lost. Waiting to join communication ring
FC BUS (zone bus)	Green	Blink - 2 Hz	Blink - 2 Hz = Data transmission. Normal communication Off steady = No data transmission. Auto baud not supported On steady = Communication lost. Waiting to join communication ring
EOL	Amber	Off	On steady = EOL is active Off steady = EOL is not active

Communication bus problems

Communication problems include cases when devices fail to connect or connect intermittently. One of the following factors can influence the behavior of the zone communication bus and cause communication problems.

Input and output wiring problems

If you wire the ZEC510 incorrectly, communication problems can occur.

Invalid address

The VAV controller must have the address switch set to a range between **4** - **127**.

Duplicate addresses

Two or more devices on a communication bus cannot have the same address. If two devices on the same bus have the same address, performance can degrade or serious communication problems can occur. You can check for duplicate addresses in the following ways:

- If a specific device is not communicating, remove the device and check if the device address remains online on the SBH. This determines if another device is using the address.
- If the bus communication problems are severe and no communication is present or you cannot determine where communication is unreliable, partition (disconnect and isolate) a portion of the bus and test the bus portion connected to the Zone Coordinator.

Correcting physical communication bus problems

The communication bus is subject to a number of physical factors that can affect performance. Use the following list to check and correct common physical problems that affect the communications bus:

- Check the status LED to verify that the controller has power.
- Check the wires for the following:
  - Verify that the wire is a 22 AWG (0.6 mm) three-conductor, twisted, shielded cable.
  - Verify that the shield is continuous and hard-grounded at one end.
- Check the wiring:
  - Check for and eliminate T-taps, wire configurations that create a T shape, and star configurations.
  - Ensure that the bus is wired in a daisy-chain configuration.
  - Verify that the appropriate devices have three wires entering and exiting each terminal.

    Note: Devices at the ends of the trunk have one wire entering and exiting each terminal.
- Check EOL switch settings:
  - Verify that the zone bus EOL switch on the Zone Coordinator is set to **ON** and the Zone Coordinator is located at the end of the zone bus trunk.
  - Verify that only the EOL switch at the end of the zone bus is set to **ON** and all other zone bus EOL switches are set to off.
- Check connections, polarity, and lengths:
  - Verify that communications loops are less than 1,000 ft (304 m) total in length.
  - If you are using one transformer to power multiple devices, verify that the device 24 VAC power connection follows the polarity of the common and 24 V terminations (see *System and zone bus supply power wiring guidelines*).
- Check for opens and short circuits.
- Check terminations.
- Check for sources of interference.

- Check the following bus voltages:
  - (**+**) to **COM** must be within 2.0 VDC to 3.0 VDC
  - (**-**) to **COM** must be within 1.5 VDC to 2.54 VDC
  - (**+**) to (**-**) must be within 0.3 VDC to 1.0 VDC

  Note: Values can fluctuate due to ongoing communications; this operation is normal when the voltage is within the defined range.

Repair Information

If the ZEC510 controller fails to operate according to its specifications, replace the unit. For a replacement unit, contact the nearest Verasys representative.

Technical specifications

ZEC510 VAV Controller technical specifications

Product code number	**LC-ZEC510-x**
Power supply requirement	20 VAC to 30 VAC at 50 Hz to 60 Hz, Class 2 power supply or safety extra-low voltage (SELV) at 50 Hz / 60 Hz (20 VAC minimum)
Power consumption	10 VA, maximum 14 VA
Ambient conditions	Ambient Operating Conditions: 0°C to 50°C (32°F to 122°F); 10% to 90% RH condensing Ambient Storage Conditions: -40°C to 85°C (-40°F to 185°F); 10% to 90% RH
Processor	20 MHz Renesas® H8S2398 processor
Memory	1 MB flash non-volatile memory for operating system, configuration data, and operations data storage and backup. 512 k Synchronous Random Access Memory (SRAM) for operations data dynamic memory.
Mounting	On a flat surface with screws
Dimensions (Height x width x depth)	140 mm x 140 mm x 25 mm (5-1/2 in. x 5-1/2 in. x 1 in.)
Shipping weight	0.30 lb (0.14 kg)
Compliance	**United States** UL Listed, File E107041, CCN PAZX, UL 916 FCC Compliant to CFR47, Part 15, Subpart B, Class A
	Canada UL Listed, File E107041, CCN PAZX7, CAN/CSA C22.2 No. 205, Signal Equipment Industry Canada Compliant, ICES-003

European Single Point of Contact:

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45143 ESSEN
GERMANY

NA/SA Single Point of Contact:

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MILWAUKEE WI 53202
USA

APAC Single Point of Contact:

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C/O CONTROLS PRODUCT MANAGEMENT
NO. 22 BLOCK D NEW DISTRICT
WUXI JIANGSU PROVINCE 214142
CHINA

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