



## SZ1143b

General Purpose Controller



## Description

The SZ1143b is a microprocessor-based general purpose controller. Because it has four distinct control sequences, it is designed for use in a wide variety of applications. These applications are: general control, remote setpoint control, general input reset ratio control and differential input (i.e. temperature, pressure, humidity, etc.) control.

## Features

- Two 4 to 20 mA analog inputs suitable for a broad variety of transducers
- Two digital inputs for switches, alarms, clocks, etc.
- One 4-20 mA modulating output
- Two relay outputs
- Adjustable P+I+D control on modulating output
- Adjustable offsets and differentials on relay outputs
- Application sequences include:
  - Humidification
  - Dehumidification
  - Dew Point Control
  - High/Low Signal Control
  - Differential Temperature
  - Differential Pressure
  - Static Pressure
  - Hot or Chilled Water
  - Hot or Chilled Water Reset
  - Stand-alone or network operation

## Mounting

The SZ1143b is designed for mounting using two #10 sheet metal screws.

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# Wiring

The SZ1143b uses terminal designations for wiring. See diagram below.

## TRANSMITTER WIRING

The SZ1143b accepts two 2-wire, 4-20mA transmitters. Use our TH Series for relative humidity sensing, TS/TX Series for temperature sensing, or TD/TL Series for differential air sensing.

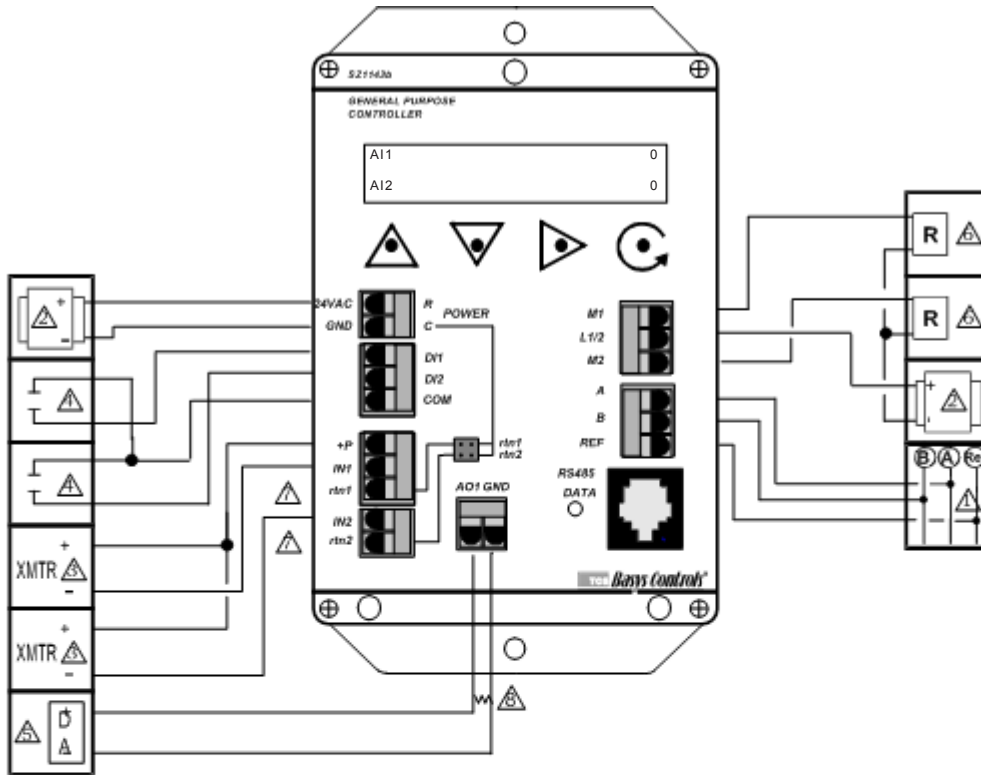
## POWERING THE SZ1143b



The SZ1143b is powered from 24 VAC +/- 20 %.

**Caution:** Do not connect to 120 VAC. When multiple TCS Basys Controls devices are using a single transformer, the polarity of the power wiring must be maintained because all TCS devices are half-wave rectified and have common return paths.

If wiring for communications, dedicated power must be used to power the controller. Several S series controllers may be powered from the same transformer, provided that the transformer has sufficient power. (Supertrols require 5 VA @ 24VAC.)



- |  |  |
|--|--|
| <p><b>1</b> For communication wiring, use twisted, shielded 18 AWG. Must be run separately.</p> <p><b>2</b> 24 VAC transformer. See powering instructions.</p> <p><b>3</b> 2-wire, 4-20mA transmitter. AWG, twisted, shielded pair.</p> <p><b>4</b> Dry contact. Must not be powered.</p> <p><b>5</b> 4 to 20 mA output. 600 ohm max. Do not power actuator with power from the thermostat. The thermostats are half-wave rectified, whereby the power ground is comon with the signal ground.</p> | <p><b>6</b> Dry contact rated 24 VAC @ 2 A.</p> <p><b>7</b> See Analog Inputs in the Operation Section</p> <p><b>8</b> Add 500Ω resistor (included in bag) to convert 0/4 to 20mA to, 0/2 to 10 VDC.</p> |
|--|--|



# Programming

The SZ1143b may be programmed through the display and keypad, or with a PC.

If programming with a PC, the following must be set through the keypad prior to programming:

- Address (step #2)
- Baud rate (step #3)

For more information on programming through the PC, consult your TCS software manual.

## PROGRAMMING THROUGH THE KEYPAD

To access the programming screens, press both the "Scroll" and "Next" keys simultaneously.

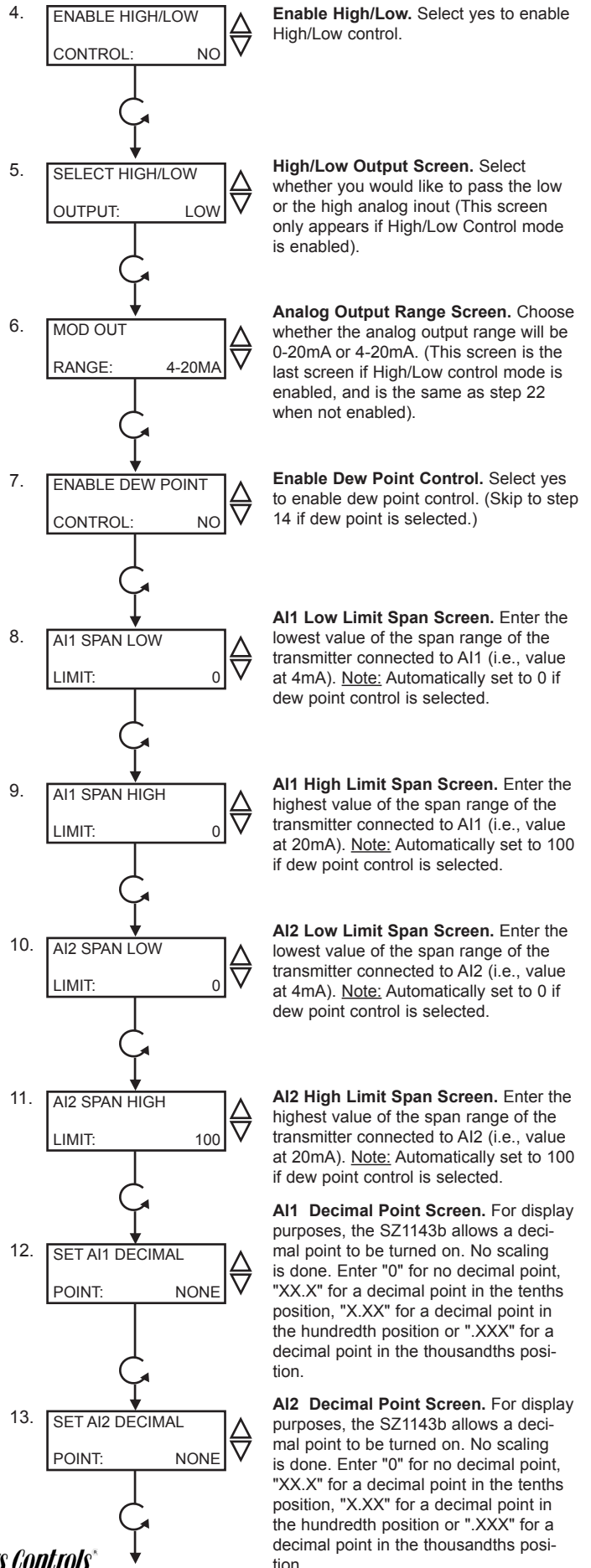
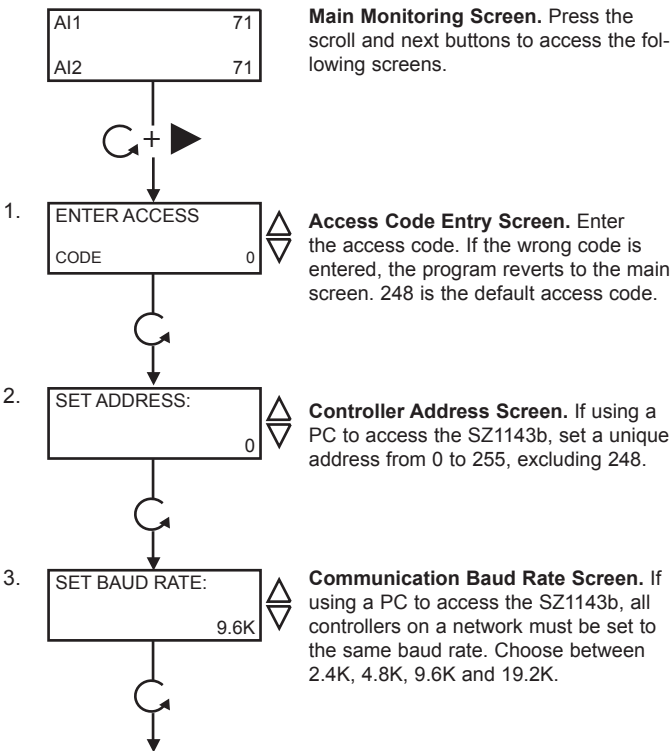
**Scroll Key** - The "Scroll" key is also used to save any changes to the "current" screen and advance to the next screen while programming. The "Scroll" key is used to enter the Programming Mode when pressed with the "Next" key.

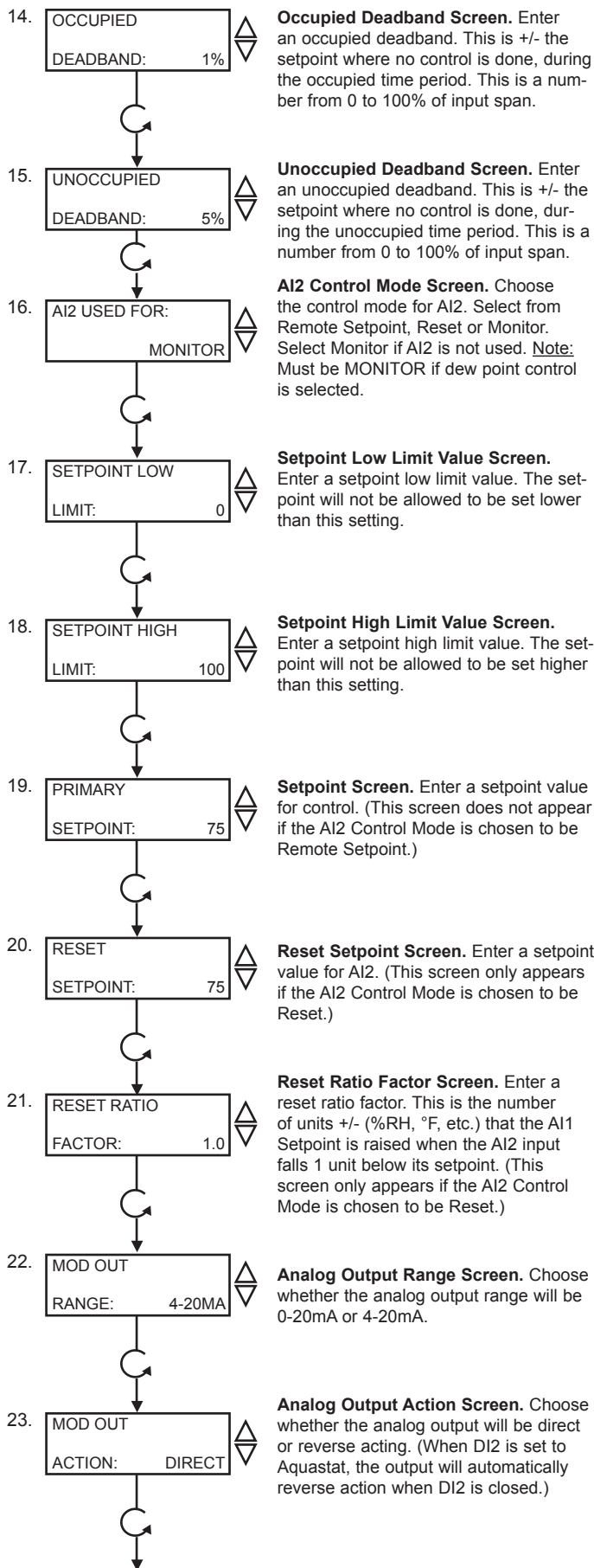


**Next Key** - Used to enter Programming Mode when pressed with the "Scroll" key. Also used to exit programming without saving changes to the current screen. In monitoring mode, the "Next" key is used to scroll backwards.



**Increment/Decrement Keys** - Used to select the desired value.





**Occupied Deadband Screen.** Enter an occupied deadband. This is +/- the setpoint where no control is done, during the occupied time period. This is a number from 0 to 100% of input span.

**Unoccupied Deadband Screen.** Enter an unoccupied deadband. This is +/- the setpoint where no control is done, during the unoccupied time period. This is a number from 0 to 100% of input span.

**AI2 Control Mode Screen.** Choose the control mode for AI2. Select from Remote Setpoint, Reset or Monitor. Select Monitor if AI2 is not used. Note: Must be MONITOR if dew point control is selected.

**Setpoint Low Limit Value Screen.** Enter a setpoint low limit value. The setpoint will not be allowed to be set lower than this setting.

**Setpoint High Limit Value Screen.** Enter a setpoint high limit value. The setpoint will not be allowed to be set higher than this setting.

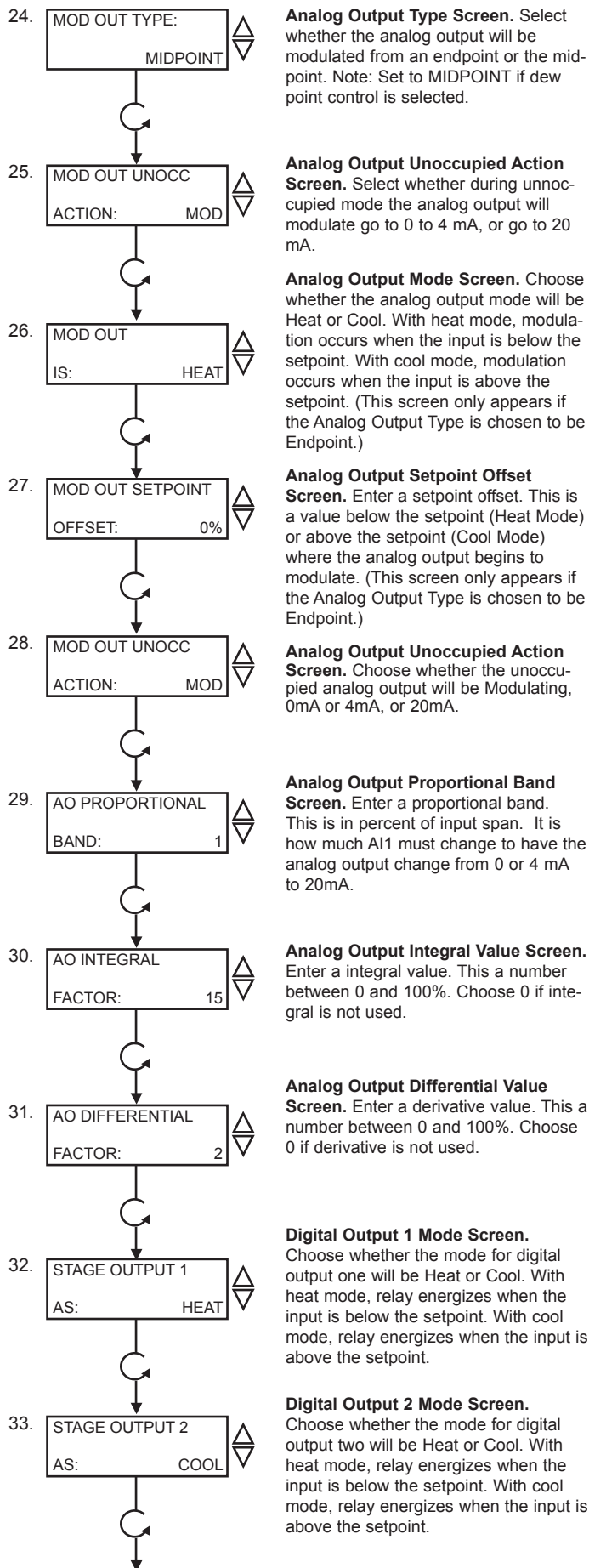
**Setpoint Screen.** Enter a setpoint value for control. (This screen does not appear if the AI2 Control Mode is chosen to be Remote Setpoint.)

**Reset Setpoint Screen.** Enter a setpoint value for AI2. (This screen only appears if the AI2 Control Mode is chosen to be Reset.)

**Reset Ratio Factor Screen.** Enter a reset ratio factor. This is the number of units +/- (%RH, °F, etc.) that the AI1 Setpoint is raised when the AI2 input falls 1 unit below its setpoint. (This screen only appears if the AI2 Control Mode is chosen to be Reset.)

**Analog Output Range Screen.** Choose whether the analog output range will be 0-20mA or 4-20mA.

**Analog Output Action Screen.** Choose whether the analog output will be direct or reverse acting. (When DI2 is set to Aquastat, the output will automatically reverse action when DI2 is closed.)



**Analog Output Type Screen.** Select whether the analog output will be modulated from an endpoint or the midpoint. Note: Set to MIDPOINT if dew point control is selected.

**Analog Output Unoccupied Action Screen.** Select whether during unoccupied mode the analog output will modulate go to 0 to 4 mA, or go to 20 mA.

**Analog Output Mode Screen.** Choose whether the analog output mode will be Heat or Cool. With heat mode, modulation occurs when the input is below the setpoint. With cool mode, modulation occurs when the input is above the setpoint. (This screen only appears if the Analog Output Type is chosen to be Endpoint.)

**Analog Output Setpoint Offset Screen.** Enter a setpoint offset. This is a value below the setpoint (Heat Mode) or above the setpoint (Cool Mode) where the analog output begins to modulate. (This screen only appears if the Analog Output Type is chosen to be Endpoint.)

**Analog Output Unoccupied Action Screen.** Choose whether the unoccupied analog output will be Modulating, 0mA or 4mA, or 20mA.

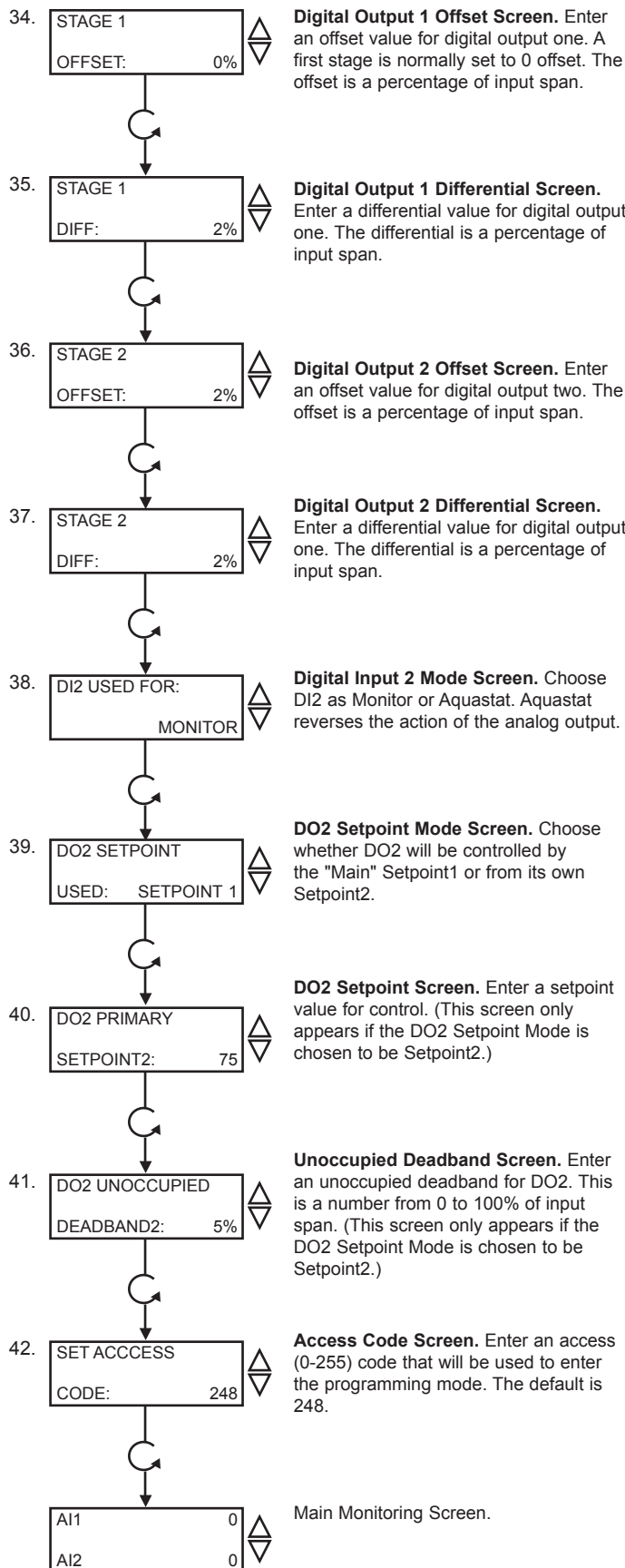
**Analog Output Proportional Band Screen.** Enter a proportional band. This is in percent of input span. It is how much AI1 must change to have the analog output change from 0 or 4 mA to 20mA.

**Analog Output Integral Value Screen.** Enter an integral value. This a number between 0 and 100%. Choose 0 if integral is not used.

**Analog Output Differential Value Screen.** Enter a derivative value. This a number between 0 and 100%. Choose 0 if derivative is not used.

**Digital Output 1 Mode Screen.** Choose whether the mode for digital output one will be Heat or Cool. With heat mode, relay energizes when the input is below the setpoint. With cool mode, relay energizes when the input is above the setpoint.

**Digital Output 2 Mode Screen.** Choose whether the mode for digital output two will be Heat or Cool. With heat mode, relay energizes when the input is below the setpoint. With cool mode, relay energizes when the input is above the setpoint.



## Operation

### UNOCCUPIED SETBACK

The SZ1143b operates in either an occupied or unoccupied mode. During the occupied mode, the occupied deadband will be used. During the unoccupied mode, the unoccupied deadband will be used.

Digital Input 1 is used to set the occupied and unoccupied mode of the SZ1143b. If the connection from "DI1" to "COM" (ground) is "Open", the SZ1143b functions in Occupied Mode. If the connection from "DI1" to "COM" (ground) is "Closed", or "Shorted", the SZ1143b functions in Unoccupied Mode.

### ANALOG INPUT

The SZ1143b's 4 to 20mA inputs utilize differential input circuits. The +P terminal is a DC power supply for 2-wire (loop powered) 4 to 20mA inputs. To connect a 2-wire 4 to 20mA transmitter (temperature, pressure, humidity) to the SZ1143b, connect the +P terminal of the SZ1143b to the (+) terminal of the transmitter and connect the IN1 (or IN2) terminal of the SZ1143b to the (-) terminal of the transmitter. Leave the respective RTN1 or RTN2 jumper installed. This jumper connects terminal RTN1 or RTN2 to the GND or C terminal and completes the circuit.

If connecting a self powered 4 to 20mA signal to the SZ1143b, connect the (+) signal to the IN1 (or IN2) terminal of the SZ1143b and the (-) signal or return to the RTN1 (or RTN2) terminal of the SZ1143b. Remove the respective RTN1 or RTN2 jumper.

If sending one signal to two SZ1143b units, for example outdoor air temperature, Connect the +P terminal one of the SZ1143b's to the (+) terminal of the transmitter. Connect the (-) terminal of the transmitter to the IN1 (or IN2) terminal of the second SZ1143b. Connect the RTN1 (or RTN2) terminal of the second SZ1143b to the IN1 (or IN2) terminal of the first SZ1143b. Remove the RTN1 (or RTN2) jumper from the second SZ1143b. Refer to "Sharing analog inputs on an SZ1143b" Application note for more detail.

### HIGH / LOW CONTROL

The analog input and analog outputs can be setup to perform High/Low signal selection. This is done by selecting "YES" in programming step # 4. When using the SZ1143b as a High/Low signal selector no other modes of operation work.



Simply wire 2 4-20mA devices into IN1 and IN2, in programming step #4 select "YES", step # 5 select whether you would like to pass the "LOW" or the "HIGH" of the 2 4-20mA signal that are wired. Either the highest or to lowest shall be passed directly to the AO1. Step # 6 in the programming screens allows yo to rescale the IN's for 4-20mA to 0-20mA be selecting "0-20mA". See conversion chart below.

4-20mA	0-20mA	4-20mA	0-20mA	4-20mA	0-20mA	4-20mA	0-20mA	4-20mA	0-20mA
4.00	0.00	8.00	5.00	12.00	10.00	16.00	15.00	20.00	20.00
5.00	1.25	9.00	6.25	13.00	11.25	17.00	16.25		
6.00	2.50	10.00	7.50	14.00	12.50	18.00	17.50		
7.00	3.75	11.00	8.75	15.00	13.75	19.00	18.75		

**DEW POINT CONTROL**

The analog output and digital outputs on the SZ1143b can be setup to use a calculated dew point temperature as the actual input. This is done by selecting "YES" in programming step # 7. When using dew point control, AI1 is the temperature input (automatically scaled for 0 to 100 °F) and AI2 is the relative humidity input (automatically scaled for 0 to 100 %RH). In programming screen #19, you are asked to enter a primary setpoint which is the dew point setpoint. This setpoint will typically be the temperature of the area where condensation is a potential problem , (i.e. cooler temperature, freezer temperature, supply air temperature). The analog and digital outputs behave as they normally would but use the calculated dew point, the primary setpoint, and their programmed parameters (heat/cool, proportional band offsets, differentials, etc.).

Example: Door Heater Control in a Convenience Store. The temperature inside the store is 76°F with 49% relative humidity. The coolers are kept at 37°F (entered as the setpoint in programming screen #19).

The calculated dew point comes out to be 55°F, so:

DO1 will be OPEN (if factory defaults are used and stage 1 is set to HEAT).

DO2 will be CLOSED (if factory defaults are used and stage 2 is set to COOL).

AO1 will modulate based on the setpoint of 37°F, an input of 55°F, the deadband

(programming screens #14 and #15), and the settings chosen in programming screens #22 through #31.

**AI2 MODE / PARAMETERS**

Analog input two can be selected as either "Monitor", "Remote Setpoint" or "Reset".

If monitor is chosen, the analog output and digital outputs are controlled based on a comparison between the scaled AI1 value and the setpoint entered in programming step #19.

If remote setpoint is chosen, the analog output and digital outputs are controlled based on a comparison between the scaled AI1 value, and the "setpoint" or "scaled AI2 value".

If reset is chosen, the analog output and digital outputs are controlled based on a comparison between AI1 and a calculated setpoint derived from the scaled AI2 value, the reset setpoint entered in programming step #17 and the reset factor entered in programming step #18.

**RESET**

The analog output and digital outputs on the SZ1143b can be setup to use a reset function. This is done by selecting "Reset" in programming step # 16. When using the reset function, AI1 is the "Primary" input and AI2 is the "Reset" input.

In programming screen #19, you are asked to enter a primary setpoint. This setpoint will be adjusted up and down based on the AI2 value, the reset setpoint and the reset factor. AI1 will be controlled to this calculated setpoint by modulating the device connected to the analog output.

In programming screen #20, you are asked to enter a reset setpoint. A comparison between AI2 and this setting will be used in determining the calculated setpoint for AI1.

In programming screen #21, you are asked to enter a reset ratio factor. This is the number of units that the AI1 setpoint is raised when the AI2 value falls below the reset setpoint by 1 unit, or the number of units that the AI1 setpoint is lowered when the AI2 value rises above the reset setpoint by 1 unit.

Example: A hot water valve is controlled using an out-



door air reset schedule. If the outdoor air is 0°F, the hot water is controlled at 180°F. If the outdoor air is 60°F, the hot water is controlled at 110°F.

The setpoint in programming step #19 is set to 145.

$$(180 + 110) / 2 = 145$$

The reset setpoint in programming step #20 is set to 30.

$$(0 + 60) / 2 = 30$$

The reset factor in programming step #211 is set to 1.167.

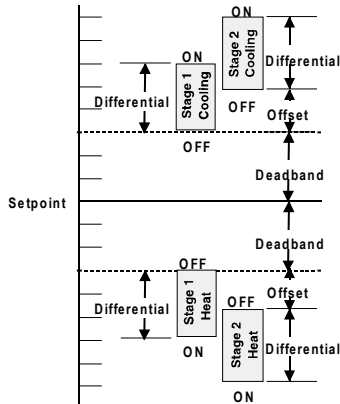
$$(180 - 110) / (60 - 0) = 70 / 60 = 1.167$$

### DO2 MODE / PARAMETERS

Digital output two can be selected as either Setpoint1 or as Setpoint2 entered in programming step #39.

If SP is chosen, programming step #40 will not be shown. Digital output two will function normally, being controlled by the Main Setpoint1 entered in programming steps #16 through #21.

If Setpoint2 is chosen, digital output two will be controlled independently based on the setpoint entered in programming step #40, the mode entered in programming step #33 and the offset and differential entered in programming step #36 and #37, and the occupied deadband entered in programming step #15 or the unoccupied deadband entered in programming step #41.



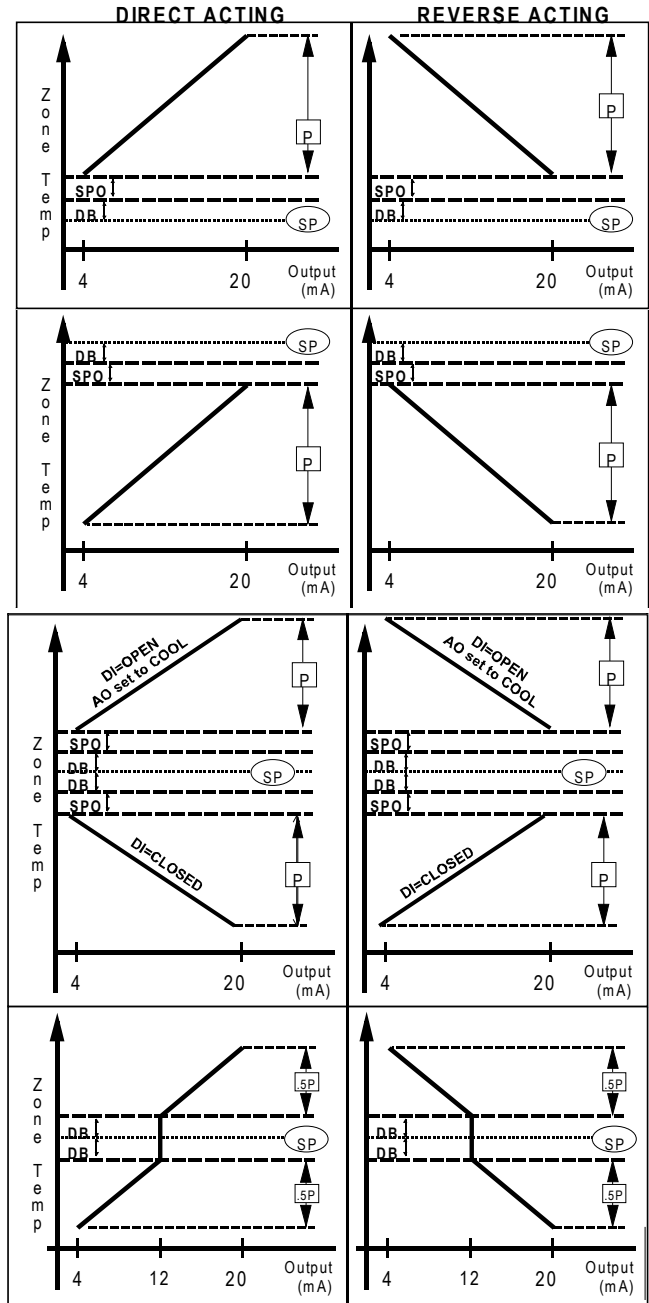
### STAGE OUTPUT PARAMETERS

The SZ1143b will control either two stages of “heating” or “cooling” or will control one stage of each. Heating refers to the Relay Output energizing on a “fall in input”, while Cooling refers to the Relay Output energizing on a “rise in input”.

For each stage, you may specify an offset and a differential value. The offset value is the amount away from the setpoint a stage will turn off. By assigning a stage a value other than zero, you “anticipate” that the residual heat or cooling in the duct or the other stages will bring the temperature back to setpoint. In most cases, the first stage is set to zero. The differential value is the difference between the on and off points.

### ANALOG OUTPUT PARAMETERS

Use programming steps #22 through #31 to program the operating parameters for the analog output. Select whether the analog output modulates from midpoint or endpoint. If endpoint is chosen, select whether the analog output is for “heating” or “cooling” and enter a setpoint offset. “Heating” refers to the analog output operating below the setpoint. “Cooling” refers to the analog output operating above the setpoint. Select direct or reverse action. Select whether you want the analog output to modulate from 4 to 20mA or 0 to 20mA. Select the unoccupied action (“20mA, 0mA or 4mA” will hold



the analog output device open or closed during unoccupied times. "Modulating" will modulate the analog output device to maintain the "unoccupied" setpoint.). Enter a proportional band (throttling range) in percent.

For proportional only control, set the integral and derivative values to zero.

If using integral and/or derivative control, also enter the integral and derivative values. If either the integral or the derivative values is non-zero, the proportional band is no longer a proportional value, but a gain value.

For PID control, lowering each of the three constants slows down the response, and raising each of the three constants speeds up the response.

### DI2 AQUASTAT

When DI2 is selected to have an aquastat function, operation is as follows.

With DI2 "Open", the analog output operates in its programmed mode. When DI2 is "Closed", the analog output uses the opposite of the selected direct or reverse action, and if the analog output has been selected to modulate from endpoint, the analog output uses the opposite of the selected heat or cool mode.

### BUILT-IN DELAYS

The SZ1143b has delays built into the programming sequences to protect equipment. Each stage has a minimum on and off time of two minutes. There is a minimum of two minutes between when one stage turns on until the next stage is allowed to turn on, as well as when one stage turns off until the next stage is allowed to turn off.

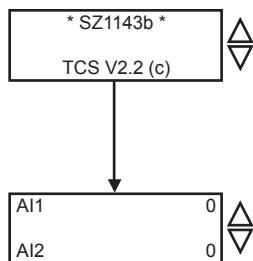
## Checkout & Troubleshooting

### CHECKOUT

**Note:** The stages have a minimum on and off time of 2 minutes.

You may verify the status of the stages and analog output in monitoring screens 3, 4, and 5, which are accessed by pressing the "Scroll" key.

1. Verify all wiring prior to powering the controller.
2. Turn power on. The controller will display a momentary screen with the model number, another momentary screen with the version number and then the main monitoring screen with the current AI1 value.
3. Take note of the current AI1 reading. Go into programming mode. Go to programming step #16 and set AI2 mode to monitor.



4. Go to programming step #16 and make the setpoint much higher than the current AI reading. If the digital output(s) are set for heat mode, the digital output(s) should come on. If the digital output(s) are set for cool mode, the digital output(s) should go off. If the analog output is set to direct acting, it should go to 0% (0 or 4mA). If the analog output is set to reverse acting, it should go to 100% (20mA).
5. Go to programming step #21 and make the setpoint much lower than the current AI reading. If the digital output(s) are set for heat mode, the digital output(s) should go off. If the digital output(s) are set for cool mode, the digital output(s) should come on. If the analog output is set to direct acting, it should go to 100% (20mA). If the analog output is set to reverse acting, it should go to 0% (0 or 4mA).
6. Go back and reprogram programming step #16 and/or #21 for operation.

### TROUBLESHOOTING

#### No Display

Check for 24 VAC on terminals 24VAC "R" and GND "C".

#### Relay Outputs Do Not Come On

Check the setpoint, deadbands, offsets and differentials. Check to be sure that the digital outputs are programmed properly for "heating" or "cooling" (make on fall, make on rise), and that they are not disabled. Short "L1/2" to "M1" to bypass digital output one, and "L1/2" to "M2" to bypass digital output two. This is a check for a mechanical relay failure.

#### Wrong Temperature Display

If either of the two analog input readings is slightly high or low, the respective Low and High scaling limits can be adjusted slightly. Let's say that the AI1 value is 5° Low and that AI1 has a span from -40 to 160°F. Change the scaling for the Low and High scaling limits to be -35°F to 165°F, instead of -40°F to 160°F. You can also measure DC voltage from "AI1" to GND "C" and "AI2" to GND "C". The 4 to 20mA inputs are represented as 1 to 5VDC signals here. Using this knowledge, you can determine whether the problem is with the controller or your input device.

#### Outputs Will Not Shut Off

First check the AI1 value and the setpoint and deadbands, then determine whether the output should be on. There are delays and minimum on and off times for the relay stages. Also, check the monitoring menus to verify that the digital outputs are on. Pulling the terminal with the 24VAC "R" and GND "C" wires off, will instantly turn all outputs off and reset the controller.

#### Analog Output Not Working Properly

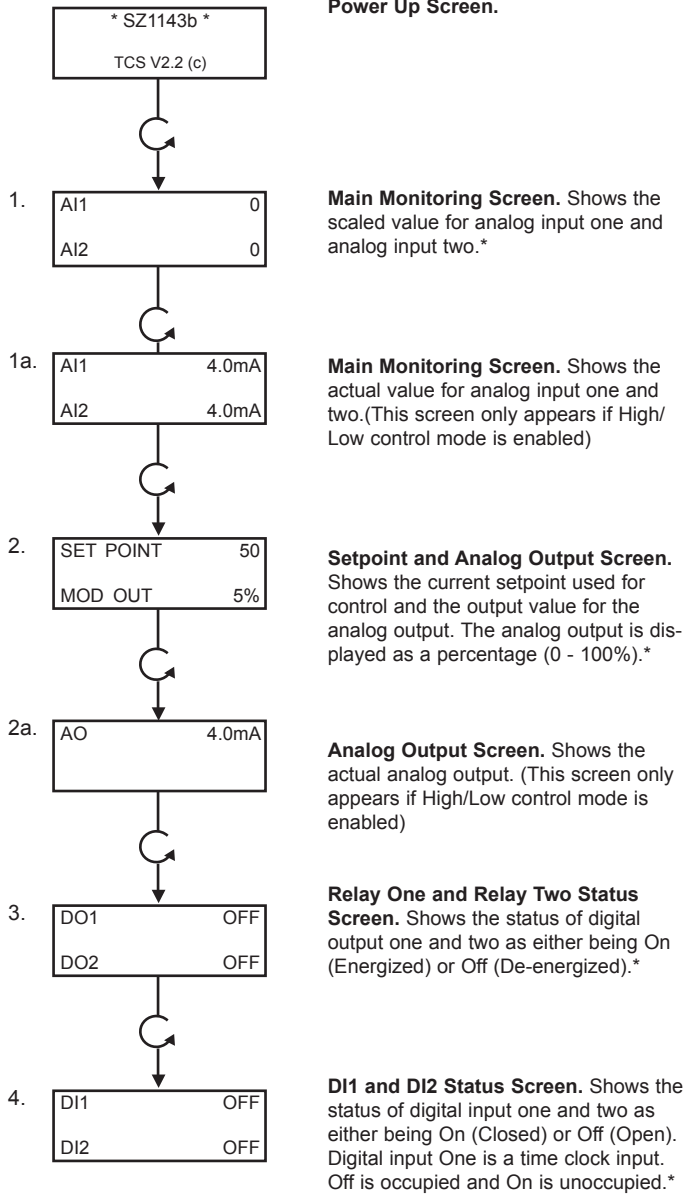
Check wiring. A separate transformer should be used for the SZ1143b and a separate transformer should be used for the modulating device. Check to make sure that the analog output is programmed correctly.



Check the Monitoring Screens. The “AO” Screen will tell you what the SZ1143b is trying to put out for an output. Compare this with the actual position of the modulating device.

### MONITORING SCREENS

Continually pressing the scroll button allows more extensive monitoring. The screens are shown below.



\* (This screen does not appear if High/Low control mode is enabled)

## LED Description

### PROGRAM/DATA

The Program/Data LED will be lit when the controller is within the programming or clock setup menus. It will blink when the unit is being accessed by a PC.