



SZ2161

Heat Pump
Water Loop Controller

Description

The SZ2161 is a microprocessor-based controller designed for water source heat pump plant control applications.

Features

- Stand-alone or network operation
- 365-day time clock with two holiday schedules, automatic leap year and daylight savings correction
- No backup battery required for control parameters, schedule or clock
- Supply and return condenser water temperature inputs
- Supply and return loop water temperature inputs
- Outdoor air temperature inputs
- Four digital inputs for status
- External time clock input
- 12 digital outputs for control of
 - damper
 - spray pump
 - 2 loop pumps
 - 2 boiler pumps
 - 2 fan speed selections
 - 4 boiler stages
- Adjustable offsets and differentials on relay outputs
- Two modulating analog output for speed drive or boiler
- Mixing valve control
- Adjustable P+I+D control on modulating outputs
- LEDs for monitoring status
- Automatic rotation of pumps

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Mounting

The SZ2161 is designed for mounting using four #10 sheet metal screws. Prior to mounting, the jumpers should be placed. (See setup instructions.) If the unit will be stand-alone, all programming should be completed. If the unit will be wired for communications, a unique address should be programmed into the unit. (See programming instructions.)

Wiring

The SZ2161 terminal designations are shown below.

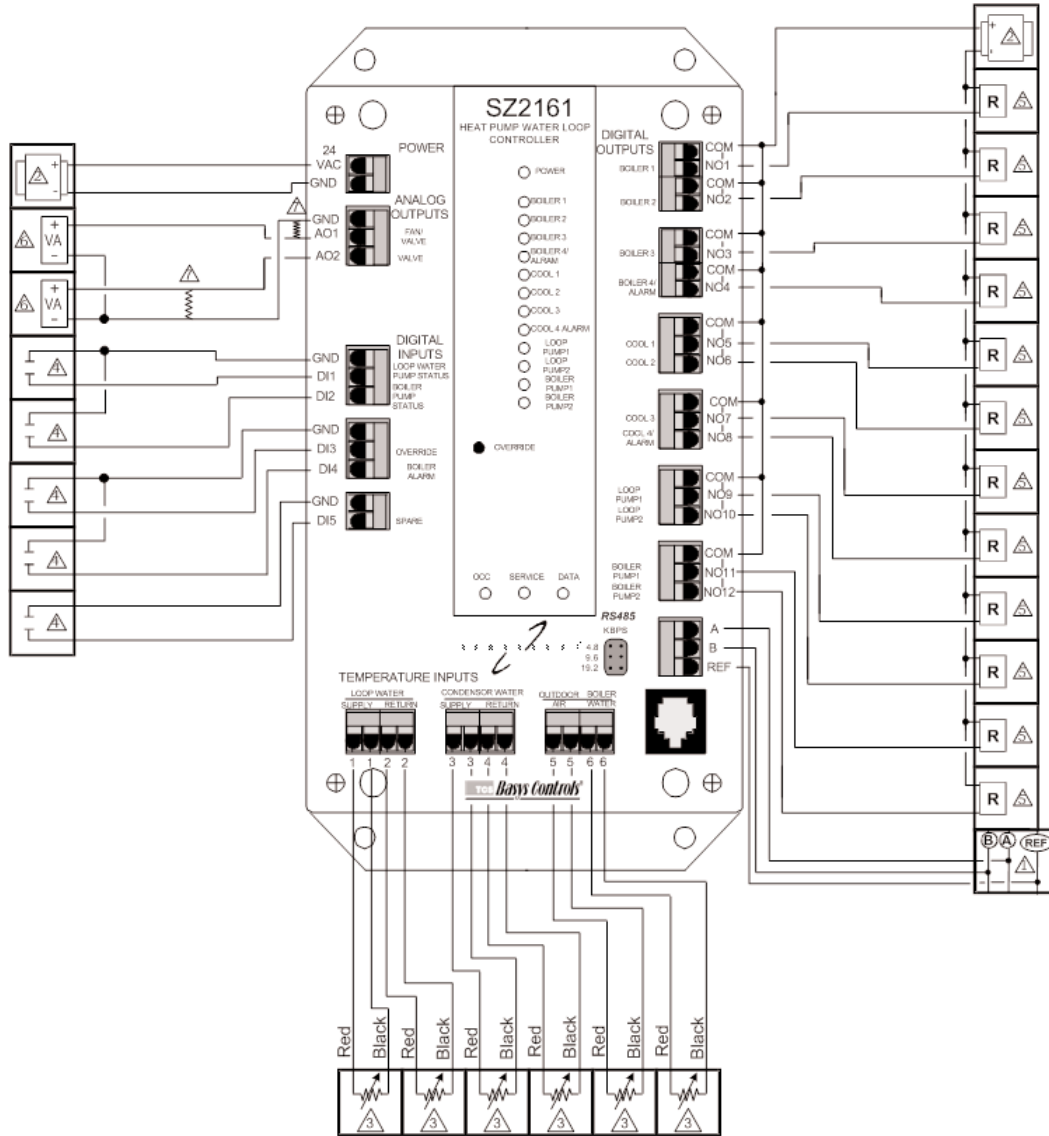
REMOTE SENSOR WIRING

The SZ2161 accepts six 1000 Ω two-wire platinum sensors. Use TS1009, TS1002 or TS1005 for water temperature sensing. Use TS1003 for outdoor air temperature sensing. When using TCS/Basys Controls three-wire sensors, use the black and red leads, and either clip or twist off the white lead. The wiring length should not exceed 250 ft.

POWERING THE SZ2161

The SZ2161 is powered from 24 VAC +/- 20 %. If wiring for communications, dedicated power must be used to power the SZ2161. Several S-series controllers may be powered from the same transformer, provided that the transformer has enough power.

Caution: 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.

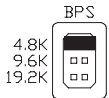
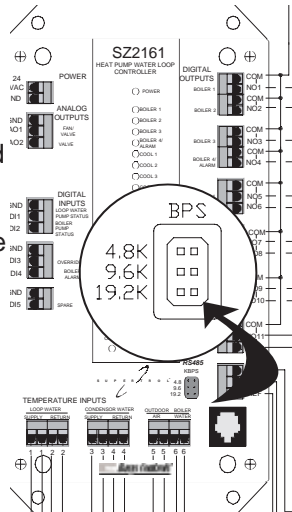


- | | |
|--|---|
| <p>1 For communication wiring, use twisted, shielded 18 AWG. Must be run separately.</p> <p>2 24 VAC transformer. See powering instructions.</p> <p>3 Sensor input wiring 18 AWG, twisted, shielded pair.</p> <p>4 Dry contact. Must not be powered.</p> | <p>5 External relay. 24 VAC Coil</p> <p>6 4 to 20 mA output. 600 ohm max. Do not power actuator with power from the controller. The controllers are half-wave rectified, whereby the power ground is common with the signal ground.</p> <p>7 Add 500Ω resistor (included in bag) to convert 0/4 to 20mA to, 0/2 to 10 VDC.</p> |
|--|---|

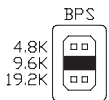
Setup

BAUD RATE SELECTION

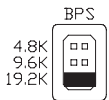
The SZ2161 must be programmed using a PC and TCS/Basys Controls software. A communication baud rate must be set by placing one jumper in the area shown above. This baud rate must be the same for all devices.



For a 4.8K baud rate.



For a 9.6K baud rate.



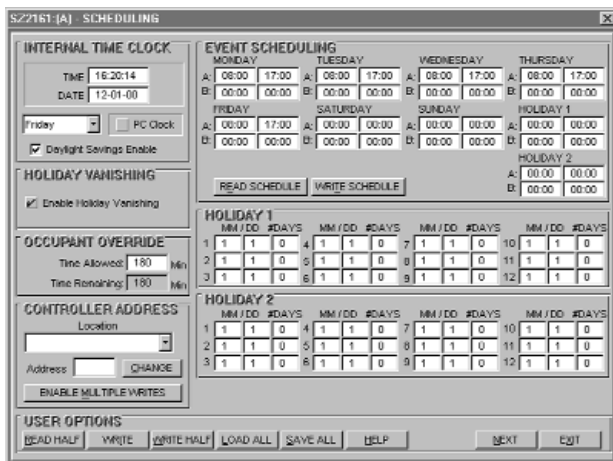
For a 19.2K baud rate

Note: for 28.8K baud, install shunts at 19.2K + 9.6K baud.

Programming

The SZ2161 must be programmed with a PC if other than factory default settings are desired. A port on the face allows local access for programming. If you plan to program the controller while it is on a network, prior to putting the controller on the network, a unique address must be set in the controller by accessing it through the port on the front.

SZ2161 screen "A"



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

CONTROLLER ADDRESS

To initialize a controller, you must first put the address of the controller here. You can either type in the address, or choose the particular controller by location. For controllers with multiple initialization screens, the address of the controller is only entered on the first screen. To write to multiple controllers, click on "Enable Multiple Writes". A list of controllers of this type are listed by location name. Select individual controllers addresses by clicking on them. You will need to use "Control"-Click or "Shift"-Click for your selection.

INTERNAL TIME CLOCK

When you read a controller, this screen displays the time (military time), the day of the week, the date and year the controller is using. When you click on "PC Clock", these same parameters are read from the computer. When "Writing" a screen of parameters to a controller, click on "PC Clock" immediately before "Write Page". This will ensure that the controller will have the proper time, day and date.

OCCUPANT OVERRIDE

This is the number of minutes from 0 to 255 (4 hours, 15 minutes) which the controller will bring an unoccupied system occupied, when its override button is pressed.

EVENT SCHEDULING

There are two occupied time periods per day, and thus two time schedules (A and B). Let us say that the occupied time for a particular day is from 8:00AM to 12:00PM and from 1:00PM to 5:00PM. In the "A" schedule you could enter 8:00 to 12:00, and in the "B" schedule you could enter 13:00 to 17:00. You can reverse the "A" and "B" schedules also. You can also enter 8:00 to 17:00 for the "A" schedule and 0:00 to 0:00 for the "B" schedule. 0:00 (12:00AM) starts the day, and 24:00 (12:00AM) ends the day. Occupied times that span midnight have to be coordinated using two days' time schedules.

Note: the start of an occupied period is delayed by the power-on delay value.

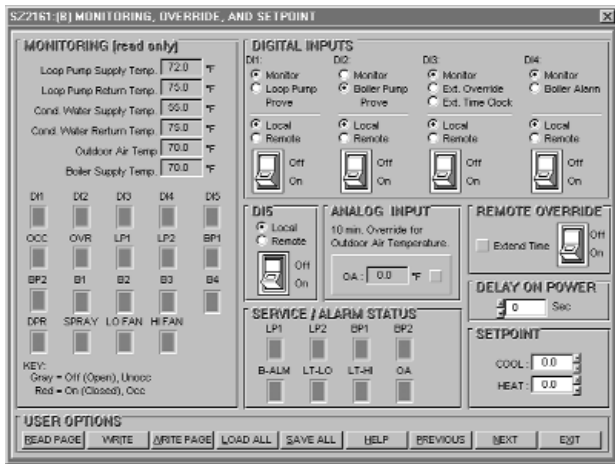
HOLIDAY 1 / HOLIDAY 2

Two sets of holidays can be programmed each using a different occupied/unoccupied time schedule. To program holidays into the controller, enter the dates as well as the length in days, for all of your holidays.

HOLIDAY VANISHING

Choose whether to enable the Holiday Vanishing Feature. If checked, the SZ2161 will make the number of days for a holiday 0 after the holiday is over. This will keep the holiday from occurring in subsequent years if it is not reprogrammed.

SZ2161 screen “B”.



MONITORING

This displays the actual temperatures connected to the controller when the controller is “read”. The boxes will be Red if the input or output is “On’ or “active”, and Gray if the input or output is “Off” or “not active”..

DIGITAL INPUTS

Select whether you want “DI”, “DI2”, “DI3”, “DI4” or “DI5” to be “Local” or “Remote”. Local means that the controller uses its own control program when looking at these inputs. Remote means that it will take a PC to make any changes to these inputs.

DI1 can be used for “Loop Pump Proving” or just “Monitoring”. If Loop Pump Proving is selected, the controller will turn on the Loop Pump and then wait 30 seconds to make sure the Pump is on (DI1 is shorted). This can be accomplished with a flow switch or some other device. Any time the Lead Loop Pump is on but DI1 is not shorted, the Lead Pump will be shut off and the Lag Pump will be started. If at any time after this, DI1 is not shorted, the "System" will be shut down. The System can be started again by briefly shorting DI1.

DI2 can be used for “Boiler Pump Proving” or just “Monitoring”. If Boiler Pump Proving is selected, the controller will turn on the Boiler Pump and then wait 30 seconds to make sure the Pump is on (DI2 is shorted). This can be accomplished with a flow switch or some other device. Any time the Boiler Pump is on but DI2 is not shorted, “Heating” will be shut down.

DI3 can be used for “Monitor”, “External Override” or “External Time Clock”. If External Override is selected, the controller will use its built in time clock and schedule to determine whether to be occupied or unoccupied, and will also be occupied as long as DI3 is On (Shorted). If External Time Clock is chosen, the controller will not use its built in time clock and schedule to determine whether to be occupied or unoccupied. The thermostat will be occupied as long as DI3 is One (Shorted) and unoccupied as long as DI3 is Off (Open). *Note: the start of an occupied period is delayed by the power-on delay value.*

DI4 can be used for a “Boiler Alarm” input (High Temperature, Low Water Level, etc.) or just “Monitoring”. If Boiler Alarm is selected, any time the Boiler is on and DI4 is not shorted, “Heating” will be shut down.

DI5

DI5 is used only for “Monitoring”.

ANALOG INPUT

The outdoor air temperature may be overridden from a PC. This would allow only one controller in a building to have an outdoor air sensor. Revelation could use this value and rebroadcast it to the remaining controllers in a building. Choose whether to use this function. You can type in a temperature which the controller will use to 10 minutes. After 10 minutes, the controller reverts back to reading its analog input i.e. if this function is used, in practice the reading must be updated at least every 10 minutes.

REMOTE OVERRIDE

In order to override the controller (put it to Occupied Mode), click the switch to “ON” and then click on WRITE. This will bring the controller to occupied mode for the amount of time set on the previous screen in the “Occupant Override” box. If the override time needs to be extended, make sure that there is a check in the box and then click WRITE. This will restart the override timer. To stop the override, click the switch to “OFF” and then click on WRITE.

DELAY ON POWER

ON a loss of power, when the power comes back, the controller will wait this amount of time before starting to control. Different controllers in one building can have different delays so that all units don’t come on at the same time. Enter a delay time (in seconds) that you want the Controller to use on power up.

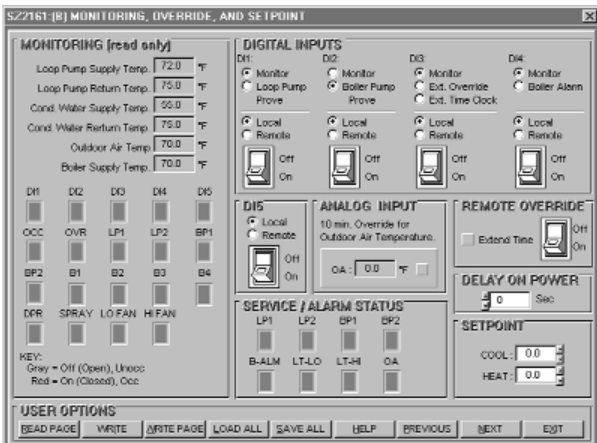
SETPOINTS

Enter the Heating and Cooling setpoints here. The heating setpoint should never exceed the cooling setpoint and the cooling setpoint should never be less than the heating setpoint.

SERVICE/ALARM STATUS

If, in the Monitoring section, the “Service” LED is ON, these additional boxes are more specific as to why the Service LED is ON. The boxes will be Red if the status is “On” or “active”, and Gray if it is “Off” or “not active”.

SZ2161 screen “C”.



OUTPUTS

For a “Cooling” output (Cool Stages) the relay energizes when the input equals the “Cooling Setpoint” + “Offset” + “Differential” and de-energizes when the input falls to the “Cooling Setpoint” + “Offset”.

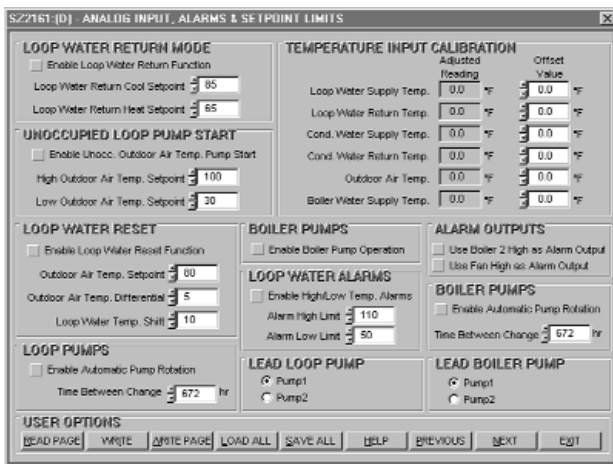
For a “Heating” output (Boiler Pump, Heat Stages) the relay energizes when the input equals the “Heating Setpoint” - “Offset” - “Differential” and de-energizes when the input rises to the “Heating Setpoint” - “Offset”.

Enter the “Offset” and “Differential” values here.

DELAYS

Enter the “Minimum ON” and “Minimum OFF” times (in seconds) here for all of the output stages, as well as a “Purge” Time and “Minimum ON and OFF” times (in minutes) for the Loop Pump.

SZ2161 screen “D”.



LOOP WATER RETURN MODE

The Loop Water Return MOde function does not allow any heating or cooling to happen until the Loop Water Return Temperature is below (heating) or above (cooling) the temperatures set here. Choose whether to enable this function and if so, enter the appropriate Loop Water Return temperatures.

UNOCCUPIED LOOP PUMP START

The Unoccupied Loop Pump Start function will start the Loop Pump if the SZ2161 is in the unoccupied mode, when the Outdoor Air Temperature is above or below the temperatures set here. Choose whether to enable this function, and if so, enter the appropriate Outdoor Air Temperatures.

LOOP WATER RESET

The Loop Water Reset Function operates as follows: when the outdoor air temperature is below the “Outdoor Air Temperature Setpoint”, the “Cool” Setpoint on Screen B will be used. When the outdoor air temperature is above the “Outdoor Air Temperature Setpoint” + the “Outdoor Air Temperature Differential”, the “Cool” Setpoint is raised by the amount of the “Loop Water Temperature Shift” value. Choose whether to use this function, and if so, enter the appropriate settings for the Outdoor Air Temperature Setpoint, Differential and Shift.

TEMPERATURE INPUT CALIBRATION

The six temperature inputs are factory calibrated. However, depending on the application (long wire runs, etc.), there may need to be a field adjustment done to these readings. The “Adjusted Reading” is the reading that the SZ2161 actually uses for control. The “Offset Value” is the number of degrees that the actual input temperature has been adjusted. For example: You measure the loop water supply temperature and it reads 71°. The SZ2161 reading is 72° and the Loop Water Supply Temperature already has an offset of -2.0°. All you need to do is change the offset value to -3.0° and you’re done. The SZ2161 will now read 71°.

The Loop Supply, Loop Return, Condenser Supply and Condenser Return inputs are all scaled 20 to 120°F (-6.7 to 48.9°C). The Boiler input is scaled 40 to 240°F (4.4 to 115.6°C). The Outdoor input is scaled -40 to 160°F (-40 to 71.1°C). These ranges are fixed and cannot be changed.

LOOP PUMPS

The Loop Pumps can be rotated automatically based on their runtimes. Choose whether to enable the Automatic Loop Pump Rotation, and if so, enter the time in hours that one pump must run before switching to and using the other pump.

LOOP WATER ALARMS

Choose whether to enable High and Low Water Temperature Alarms. You will then need to enter a High and Low Loop Water Temperature Limit.

LEAD LOOP PUMP

Choose whether Loop Pump 1 to Loop Pump 2 will be used as the Lead Loop Pump. The other one will be treated as a backup pump. This section can be used to manually alternate the loop pumps.

BOILER PUMPS

Choose whether or not to enable Boiler Pump Operation. If unselected, the boiler pump outputs will not function.

BOILER PUMPS

The boiler pumps can be rotated automatically based on their runtimes. Choose whether to enable the Automatic Loop Pump Rotation, and if so, enter the time in hours that one pump must run before switching to and using the other pump.

LEAD BOILER PUMP

Choose whether Boiler Pump 1 or Boiler Pump 2 will be used as the Lead Boiler Pump. The other one will be treated as a backup pump. This section can be used to manually alternate the boiler pumps.

ALARM OUTPUTS

The “Boiler 2 High” stage and/or the “Fan High” stage can be used as an alarm output provided one or both are not being used for control. This would typically be used to provide some type of external alarm signal such as an audible alarm.

SZ2161 screen “E”.

BOILER STAGE ROTATION

Choose whether to enable Boiler Stage Rotation. Boiler rotation is cyclical, i.e. before rotation, Boiler 1 is the first stage, Boiler 2 is the second stage, Boiler 3 is the third stage and Boiler 4 is the fourth stage. After one rotation, Boiler 2 is the first stage, Boiler 3 is the second stage, Boiler 4 is the third stage and Boiler 1 is the fourth stage. If using Boiler Stage Rotation, select the number of weeks between rotations and select the time of day that you would like the rotation to occur.

BOILER STAGES

Select the number of Boiler Stages that will be used in the Boiler Stage Rotation. If using 4 stages, you can select to “Swap” stages 1 & 2 with stages 3 & 4. This is useful if using two boilers with two stages each.

BOILER STAGE ORDERING

Select the boiler stage ordering. The term Boiler refers to the physical connections to the SZ2161. The term Stage refers to the order in which the boiler stages cycle on and off. The factory default is to have Boiler 1 be Stage 1, Boiler 2 be Stage 2, Boiler 3 be Stage 3 and Boiler 4 be Stage 4. Note: the boiler stages can be placed in any order whether using boiler rotation or not.

If boiler rotation is used, this is the starting order, after which the boiler stages will be rotated in order.

SZ2161 screen “F”.

ANALOG OUTPUT 1 / ANALOG OUTPUT 2

Each analog output on the SZ2161 is used to control a heating or cooling device (VFD). You need to choose whether each analog output will be used for heating or cooling.

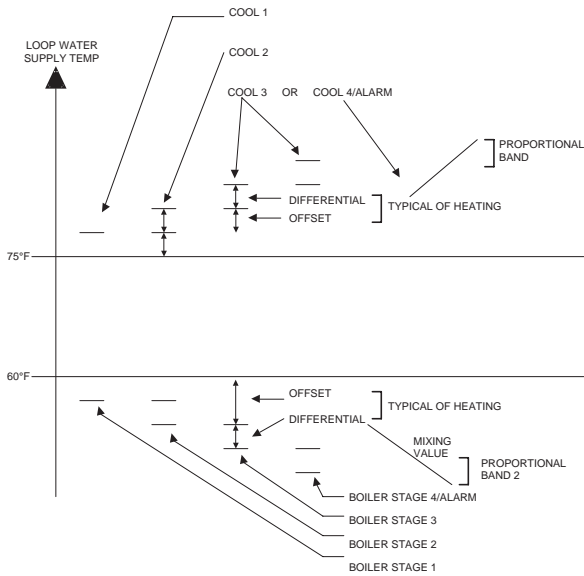
During the occupied time, an analog output modulates to maintain a heating or cooling temperature setpoint. During the unoccupied time you will need to choose whether the analog output will modulate, remain at 20 mA, or remain at (0 or 4) mA.

A proportional band (throttling range), whether you want the analog output to modulate from 4 to 20 mA or 0 to 20 mA, and direct or reverse action must also be programmed.

COMMUNICATION FAILURE

Place a check in the box labeled “Enable Communication Loss Function” only if the SZ2161 is being with a QD2100. A QD2100 will continuously poll a network and modify the operation of the SZ2161. If this communications is lost, the SZ2161 will go into occupied control mode.

Sequence of Operation



Checkout & Troubleshooting

CHECKOUT

1. Be sure to check and verify all wiring before powering the SZ2161.
2. Turn power on. The SZ2161 "Power" LED should light up. Then the Service LED will blink for 15 seconds while the electronics stabilize.
3. If the SZ2161 has not been pre-programmed, it should be programmed at this time.
4. Increase and decrease the Heat and Cool setpoints. This must be done from a PC. **Note:** The cool setpoint cannot be made smaller than the heat setpoint. Observe the operation of the relay stages and or analog output(s).
5. Note that the operation of the SZ2161 will depend on how it is programmed.

The SZ2161 is now ready for operation.

TROUBLESHOOTING

Power LED will not come on

Check for 24 VAC on terminals "24 VAC" and "GND". The rest of the troubleshooting must be done with a PC and the Revelation Professional software.

No communication

Make sure baud rate selection jumper for the QD1010 and the SZ2161 are the same, and that Revelation is configured for that same baud rate. Address 248 will always work provided that the SZ2161 is **not** connected to a network.

Inputs do not read correctly

The SZ2161 is calibrated at the factory. For the loop supply temperature and other temperature readings make slight adjustments (+/- 12% of the input span) on "Screen D" of the SZ2161 programming screens. (See Temperature Input Calibration on page 5.)

Output operation is not correct

Check programmed parameters. In particular, check "Reverse" and "Direct" acting selections and "Heat" or "Cool" selections for the analog outputs, and "Offset" and "Differential" selections and "Delay Times" for the relay outputs. Check wiring.

LED Description

Six LEDs on the unit allow the occupant to view the current operating status of the SZ2161.

POWER: This LED will be lit whenever the unit has power.

DIGITAL OUTPUTS: These LEDs will be lit when the corresponding relay outputs are on. Relay outputs include pumps, boiler stages, chiller stages, etc.

OCC: This LED will be on whenever the unit is operating in the occupied mode.

SERVICE: This LED will be on whenever the unit has a service condition. This LED also blinks on powerup until the electronics stabilize.

DATA: This LED will blink when the unit is being accessed by a PC.