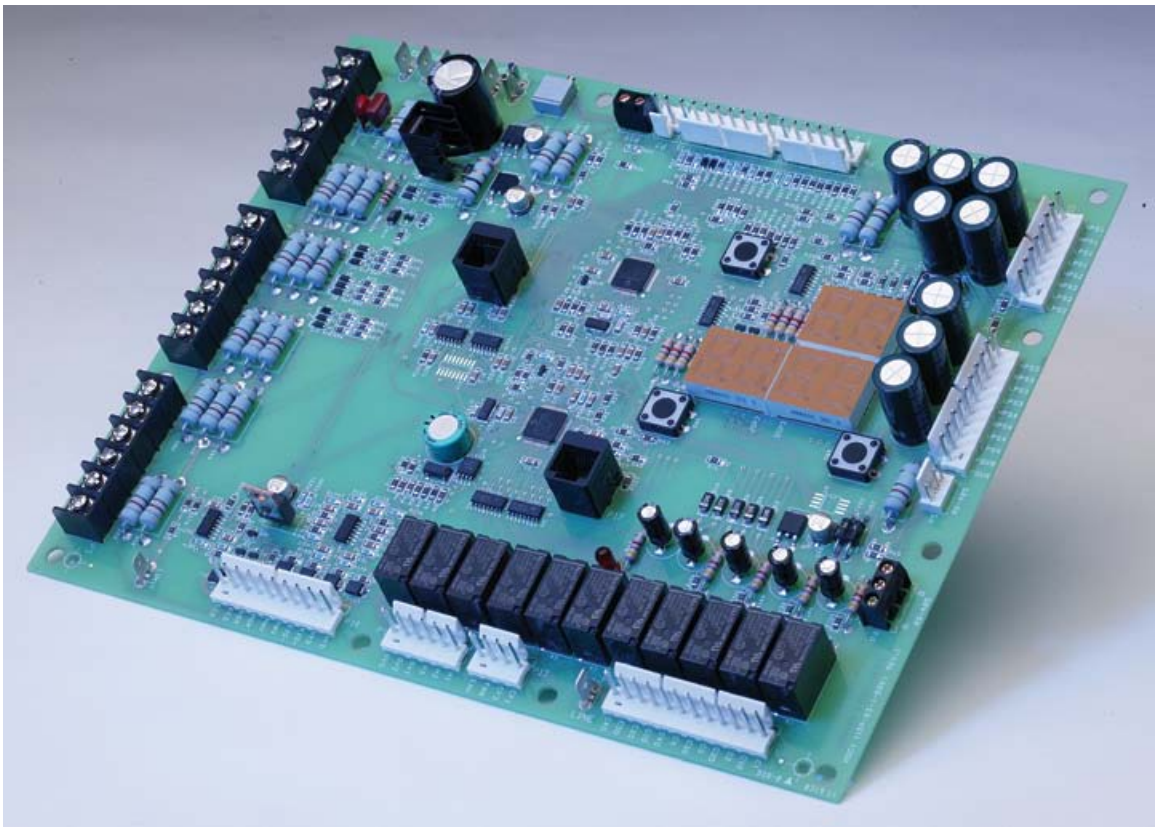
Simplicity Elite Functions



Relating Setpoints, Inputs, and Outputs To The Sequence Of Operation

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Introduction

The Simplicity Elite controller used on the York Packaged Millennium equipment is capable of performing all of the necessary unit functions. It is configurable for both constant volume and variable air volume applications. Constant volume units can be staged using sensors connected to the Elite controller or by using a wall thermostat to provide inputs. VAV units have supply air temperature reset features, including the capability of allowing an external analog input for reset. Economizer operation can be set up for dry bulb, single enthalpy, or dual enthalpy changeover. An added economizer feature allows an analog input to take direct control of the economizer actuator. Modulation of a supply fan vfd, exhaust fan vfd, and a hot water valve are also functions of the Elite controller. It is one of the most complete unit controllers in the industry.

In order to fully set up, operate, and troubleshoot the Simplicity Elite, the technician must have an understanding of the inputs, outputs, and setpoints of the controller. In addition, the technician must be able to relate this information to the sequence of operation for a specific board function. This document has been prepared for use in our Millennium Packaged Rooftop Qualification Training Class. It is also a good reference guide for the field technician performing a Milllennium start-up or troubleshooting a problem.

The first section of this guide provides details on the inputs and outputs of the Simplicity Elite controller. The second section relates the inputs, outputs, and setpoints to the sequence of operation for each specific function of the controller.

INPUTS

Temperature Sensors

1. ST, GND, and SSO
    a. 10k thermistor
    b. Space temperature sensor, offset, and unoccupied override
    c. Used for:
        i. Cool and heat staging on CV units
        ii. Supply air temperature reset on VAV
2. SAT+ and SAT-
    a. 10k thermistor
    b. Supply air temperature sensor
    c. Used for:
        i. VAV supply air temperature control
        ii. Economizer control for both CV and VAV
        iii. Supply air temperature limiting for both heating and cooling, CV and VAV
3. RAT+ and RAT-
    a. 10k thermistor
    b. Return air temperature sensor
    c. Used for:
        i. Cool and heat staging when no space sensor present or when space sensor fails

ii. VAV morning warm-up
iii. VAV occupied heating

4. OAT+ and OAT-
   a. 10k thermistor
   b. Outside air temperature sensor
   c. Used for:
      i. Economizer changeover, dry bulb, single enthalpy, and dual enthalpy
      ii. Compressor and heating cutouts

Humidity Sensors

1. OH+ and OH-
   a. 0-10 vdc
   b. Outside air humidity sensor
   c. Requires 24 vac power supply to the sensor
   d. Used for economizer changeover, single and dual enthalpy
2. RH+ and RH-
   a. 0-10 vdc
   b. Return air humidity sensor
   c. Requires 24 vac power supply to the sensor
   d. Used for economizer changeover, dual enthalpy

Pressure Sensors

1. DP+ and DP-
   a. 0-5 vdc
   b. Supply air duct pressure sensor
   c. Transducer has a pressure range of 0-5 iwc
   d. Related output VFD+ and VFD-
   e. Requires a 24 vac or 24 vdc power supply to the transducer
   f. Used to measure supply duct pressure. Elite compares actual pressure to setpoint to modulate VFD speed or guide vane position for duct pressure control on VAV
2. BP+ and BP-
   a. 0-5 vdc
   b. Building pressure sensor
   c. Transducer has a pressure range of +/- 0.25 iwc
   d. Related output EXD+ and EXD-
   e. Requires a 24 vac or 24 vdc power supply to the transducer
   f. Used to measure building pressure. Elite compares actual pressure to setpoint to modulate power exhaust discharge dampers or VFD speed to control building pressure on CV or VAV

Thermostat

1. Y1, Y2, Y3, and Y4
    a. Cooling stages
    b. 24 vac
    c. Used for CV only
2. W1, W2, and W3
    a. Heating stages
    b. 24 vac
    c. Used for CV and Unoccupied VAV
3. G
    a. Indoor blower
    b. 24 vac
4. OCC
    a. Occupied/Unoccupied mode
    b. 24 vac
    c. Parameter 71 must be turned ON

Miscellaneous Devices

1. DV+ and DV-
    a. 0-10 vdc
    b. CO2 sensor
    c. Related output ECO+ and ECO-
    d. Sensor range must be programmed into Elite with Parameter 41
    e. Demand Ventilation must be enable with Parameter 40
    f. Requires a 24 vac power supply to the sensor
    g. Used to measure CO2 level in space and modulate economizer dampers to keep CO2 level at setpoint
2. FILT and FILT
    a. Normally open switch
    b. Dirty filter switch
    c. One Filter pin is a 24 vac output
3. FSP and FSI
    a. Normally closed switch
    b. Hydronic coil freezestat (field provided and installed)
    c. FSP is a 24 vac output
4. REM+ and REM-
    a. 0-10 vdc from an external source
    b. Remote Control parameter 22 must be turned ON
    c. Used to reset SAT between VAV Lower Cooling SAT and VAV Upper Cooling SAT setpoints
    d. 2 volts equals Lower, 10 volts equals upper, linear ramping

   e. Below 1.5 vdc the cooling and heating is disabled
   f. Below 1.0 vdc the blower is de-energized
5. PURGE
   a. Smoke purge
   b. 24 vac
   c. With a 24 vac input to Purge:
      i. All heating and cooling is de-enregized
      ii. Economizer output goes to 10 vdc
      iii. Supply fan VFD output goes to 10 vdc
      iv. Power exhaust output goes to 10 vdc
6. BAS ECON + and -
   a. 2-10 vdc
   b. BAS Economizer parameter 58 must be turned ON before voltage is applied to these terminals
   c. Allows a 3rd party to take direct control of economizer damper

OUTPUTS

1. VFD+ and VFD-
   a. 2-10 vdc
   b. Supply fan vfd speed control or IGV damper actuator position on VAV
   c. Related input DP+ and DP-
2. EXD+ and EXD-
   a. 2-10 vdc
   b. Power exhaust VFD speed control or discharge damper actuator position
   c. Related to BP+ and BP-
   d. Power exhaust must be set up for modulating or vfd
3. ECO+ and ECO-
   a. 2-10 vdc
   b. Economizer actuator damper position
   c. Related inputs
      i. OAT+ and OAT-
      ii. OH+ and OH-
      iii. RH+ and RH-
      iv. SAT+ and SAT-
   d. Positions economizer damper to
      i. Minimum position
      ii. Control SAT to either Economizer 1st Stage or Economizer 2nd Stage setpoint on CV
      iii. Control SAT to either VAV Lower Cooling SAT or VAV Upper Cooling SAT setpoint
      iv. Control CO2 level
4. HWV+ and HWV-
   a. 2-10 vdc
   b. Hot water valve
   c. Related inputs:

        i. SAT+ and SAT-
        ii. FSP and FSI
    d. Hydronic Heat parameter 18 must be turned ON
    e. Modulates hydronic heat water valve to maintain either Stage 1 Hydronic Heat Sat or Stage 2 Hydronic Heat SAT setpoint
5. VAV OPEN
    a. 24 vdc
    b. Used to signal that VAV system is in heating mode
6. C1, C2, C3, and C4
    a. 24 vac
    b. Compressor stages
7. CF1 and CF2
    a. 24 vac
    b. Condenser fans
8. FAN
    a. 24 vac
    b. Used to:
        i. Energize indoor blower motor on CV and VAV w/IGV
        ii. Enable the vfd on VAV
9. EXH
    a. 24 vac
    b. Exhaust fan
    c. Used to energize the exhaust fan on non-modulating and modulating power exhaust
    d. Currently not used on VFD power exhaust with Danfoss drives
    e. Will be used to enable future VFD's
10. H1, H2, and H3
    a. 24 vac
    b. Heat stages on electric and gas heat

Safety Circuits

1. HSP1, HSP2, HSP3, and HSP4
    a. 24 vac
    b. High pressure switches for each compressor circuit
    c. The top pin in each group is a 24 vac output
    d. The bottom pin in each group is monitored for the presence of 24 vac through the safety
    e. If switch opens 3 times in 2 hours a hard lockout occurs
2. LPS1, LPS2, LPS3, and LPS4
    a. 24 vac
    b. Low pressure switches for each compressor circuit

   c. Top pin in each group is internally connected to the bottom HPS pin for 24 vac source.
   d. Bottom pin in each group is monitored for the presence of 24 vac through the safety.
   e. If the switch opens 3 times in one hour a hard lockout occurs
3. FOVR and FOVR
   a. 24 vac
   b. Used to monitor supply fan VFD for over current
   c. The top pin is a 24 vac output
   d. Bottom pin monitors for presence of 24 vac through a relay on the Danfoss VFD
   e. All units without VFD have a jumper across the terminals
4. LIM1, LIM2, and LIM3
   a. 24 vac
   b. Limit switch circuit for each heat stage
   c. Monitors for presence of 24 vac through the limit switches
5. GV1, GV2, and GV3
   a. 24 vac
   b. Gas valve verification
   c. Looks for 24 vac presence anytime the matching heat output is active

Relating Setpoints, Inputs, and Outputs to Sequence of Operation

Power Exhaust Options

Non-Modulating Power Exhaust

1. Keypad Setpoints
    a. Economizer — ON (Parameter 32)
    b. Power Exhaust — ON (Parameter 43)
    c. Modulating Power Exhaust — OFF (Parameter 44)
    d. Exhaust VFD Installed — OFF (Parameter 45)
    e. Building Pressure Sensor Enabled — OFF (Parameter 85)
    f. Econo Damper Position For Exh Fan On — Percent (Parameter 48)
    g. Econo Damper Position For Exh Fan Off — Percent (Parameter 49)
2. Inputs
    a. None
3. Outputs
    a. 2-10 vdc from ECO+ and ECO- for economizer damper output.
    b. 24 vac from EXH to energize exhaust fan
4. Operation
    a. Compares economizer output to the Economizer Damper Position For Exhaust Fan On and OFF.
    b. Energizes exhaust fan when economizer output is above Economizer Damper Position For Exhaust Fan On. Example: If ON setpoint is 50%, with a total economizer output range of 2-10 vdc, the exhaust fan will be energized when the economizer output is more than 6 volts.
    c. De-energizes exhaust fan when economizer output is below the Economizer Damper Position for Exhasut Fan OFF

Modulating Power Exhaust

1. Keypad Setpoints
    a. Power Exhaust — ON (Parameter 43)
    b. Modulating Power Exhaust — ON (Parameter 44)
    c. Exhaust VFD Installed — OFF (Parameter 45)
    d. Building Pressure Sensor Enabled — ON (Parameter 85)
    e. Exh Damper Position For Exh Fan On — Percent (Parameter 46)
    f. Exh Damper Position For Exh Fan Off — Percent (Parameter 47)
    g. Building Pressure Setpoint — IWC (Parameter 31)
    h. Building Pressure Reading — IWC (Parameter 83)
2. Inputs

   a. 0-5 vdc from building pressure sensor to terminals BP+ and BP-. Sensor has a pressure range of +/-0.25 iwc.
3. Outputs
   a. 2-10 vdc from EXD+ and EXD- for exhaust damper output.
   b. 24 vac from EXH to energize exhaust fan
4. Operation
   a. Compares building pressure (Parameter 83) to building pressure setpoint. As building pressure increases above setpoint, exhaust damper output increases to open exhaust dampers. Building pressure control band is +/-0.015 iwc.
   b. Energizes the exhaust fan when exhaust damper output is above Exhaust Damper Position For Exhaust Fan On. Example: If ON setpoint is 50%, with a total exhaust damper output range of 2-10 vdc, the exhaust fan will be energized when the exhaust damper output is more than 6 volts.
   c. De-energizes the exhaust fan when the exhaust damper output is below Exhaust Damper Position For Exhaust Fan Off.

Modulating Power Exhaust with VFD

1. Keypad Setpoints and Data

a.	Power Exhaust	ON	(Parameter 43)
b.	Modulating Power Exhaust	OFF	(Parameter 44)
c.	Exhaust VFD Installed	ON	(Parameter 45)
d.	Building Pressure Sensor Enabled	ON	(Parameter 85)
e.	Building Pressure Setpoint	IWC	(Parameter 31)
f.	Building Pressure Reading	IWC	(Parameter 83)

2. Inputs
   a. 0-5 vdc from building pressure sensor to terminal BP+ and BP-. Sensor has a pressure range of +/-0.25 iwc.
3. Outputs
   a. 24 vac from EXH to enable the VFD
   b. 2-10 vdc from EXD+ and EXD- for VFD speed control
4. Operation
   a. VFD is enabled from 24 vac output from EXH terminal any time the indoor blower is turned on.
   b. VFD speed will be modulated between 20 Hz (4.6 vdc) and 60 Hz (10 vdc) to keep building pressure at setpoint. Control band is +/-5% of building pressure setpoint. If output from EXD+ and EXD- is lower than 4.6 vdc, drive will go into sleep mode and exhaust fan will be off.

VAV Supply Air Temperature Control

Standard Control

1. Keypad Setpoints and Data

a.	Remote Control	OFF	(Parameter 22)
b.	VAV Upper Cooling SAT Setpoint	Degrees	(Parameter 23)
c.	VAV Lower Cooling SAT Setpoint	Degrees	(Parameter 24)
d.	VAV SAT Reset Setpoint	Degrees	(Parameter 25)
e.	Cooling Mode Enable	ON	(Parameter 53)
f.	Supply Air Temperature	Degrees	(Parameter 65)
g.	Return Air Temperature	Degrees	(Parameter 66)
h.	Space Temperature	Degrees	(Parameter 68)
i.	Compressors	2-4	(Parameter 80)

2. Inputs
    a. 10k NTC supply air temperature sensor to terminals SAT+ and SAT-
    b. 10k NTC return air temperature sensor to terminals RAT+ and RAT-
    c. 24 vac to C10, C20, C30, and C40 from compressor protection modules
    d. 24 vac to HPS1 through HPS4 and to LPS1 through LPS4
3. Outputs
    a. 24 vac from C1, C2, C3, and C4 compressor outputs
    b. 24 vac from CF1 and CF2 condenser fan outputs
4. Operation
    a. Control must be in an occupied mode and not in morning warm-up
    b. If return air temperature (or space temperature if sensor is installed) is above the VAV SAT Reset setpoint by more than 2 degrees the economizer will modulate and/or the compressors will be staged to control the supply air temperature within +/- 5 degrees F of the VAV Lower Cooling SAT setpoint.
    c. If the return air temperature (or space temperature if sensor is installed) is below the VAV SAT Reset setpoint by more than 2 degrees the economizer will modulate and/or the compressors will be staged to control the supply air temperature with +/- 5 degrees F of the VAV Upper Cooling SAT setpoint.
    d. If no reset is desired, both the VAV Upper Cooling SAT and the VAV Lower Cooling SAT setpoints must be set to the same value.
5. Special Notes
    a. The setpoint Supply Air Temperature For Cooling is a safety limit setpoint to prevent the supply air temperature from dropping too low and endangering the compressors.
    b. Thermostat inputs should not be used on a VAV unit except for unoccupied heating.

Supply Air Temperature Reset using Remote Control

1. Keypad Setpoints and Data

a.	Remote Control	ON	(Parameter 22)
b.	VAV Upper Cooling SAT Setpoint	Degrees	(Parameter 23)
c.	VAV Lower Cooling SAT Setpoint	Degrees	(Parameter 24)
d.	VAV SAT Reset Setpoint	Degrees	(Parameter 25)
e.	Cooling Mode Enable	ON	(Parameter 53)
f.	Supply Air Temperature	Degrees	(Parameter 65)
g.	Return Air Temperature	Degrees	(Parameter 66)
h.	Space Temperature	Degrees	(Parameter 68)
i.	Compressors	2-4	(Parameter 80)

2. Inputs
    a. 10k NTC supply air temperature sensor to terminals SAT+ and SAT-
    b. 10k NTC return air temperature sensor to terminals RAT+ and RAT-
    c. 2-10 vdc to terminal REM+ and REM-
    d. 24 vac to C10, C20, C30, and C40 from compressor protection modules
    e. 24 vac to HPS1 through HPS4 and to LPS1 through LPS4
3. Outputs
    a. 24 vac from C1, C2, C3, and C4 compressor outputs
    b. 24 vac from CF1 and CF2 condenser fan outputs
4. Operation
    a. Control must be in an occupied mode and not in morning warm-up
    b. With a 2 vdc input on REM+ and REM- the economizer will modulate and/or the compressors will be staged to control the supply air temperature within +/- 5 degrees F of the VAV Lower Cooling SAT setpoint.
    c. Wit a 10 vdc input on REM+ and REM- the economizer will modulate and/or the compressors will be staged to control the supply air temperature with +/- 5 degrees F of the VAV Upper Cooling SAT setpoint.
    d. Supply air temperature will ramp linearly between the VAV Lower Cooling SAT and VAV Upper Cooling SAT setpoints as the dc input ramps between 2 and 10 vdc.
    e. If the input goes below 1.5 vdc the compressors will be staged off and locked out.
    f. If the input goes below 1.0 vdc the fan will be turn off.

VAV Duct Pressure Control

1. Keypad Setpoints and Data
    a. Duct Static Pressure Setpoint IWC (Parameter 30)
    b. Duct Static Reading IWC (Parameter 82)
    c. Duct Static Shutdown Setpoint IWC (Parameter 88)
2. Inputs
    a. 0-5 vdc from duct pressure sensor to terminal DP+ and DP-. Sensor has a pressure range of 0 to 5.0 iwc.
3. Outputs
    a. 24 vac from FAN to energize fan motor or enable VFD
    b. 2-10 vdc from VFD+ and VFD- for positioning of inlet guide vanes or setting speed of the VFD
4. Operation
    a. When the fan is energized, the 2-10 vdc output from VFD+ and VFD- will be modulated to maintain the supply duct pressure to within +/-5% of the Duct Static Pressure setpoint.
    b. If the duct pressure reaches the Duct Pressure Shutdown setpoint, the fan and all other operating functions of the unit will be de-energized.
    c. If the unit is in a heating mode, the control will continue to vary the dc output to control duct pressure to the Duct Static Pressure setpoint. Therefore, in any VAV heating mode, all VAV boxes must be commanded to their maximum position to guarantee adequate airflow to keep the heat section high temperature limit switches from opening.

Economizer

Constant Volume

1. Keypad Setpoints and Data for Dry Bulb Changeover
    a. Economizer ON (Parameter 32)
    b. Economizer 1st Stage Degrees (Parameter 33)
    c. Economizer 2nd Stage Degrees (Parameter 34)
    d. Economizer Minimum Position Setpoint Degrees (Parameter 35)
    e. Economizer OAT Enable Setpoint Degrees (Parameter 39)
    f. Supply Air Temperature Degrees (Parameter 65)
    g. Outside Air Temperature Degrees (Parameter 67)
2. Keypad Setpoints and Data for Single Enthalpy Changeover
    a. Economizer ON (Parameter 32)
    b. Economizer 1st Stage Degrees (Parameter 33)
    c. Economizer 2nd Stage Degrees (Parameter 34)
    d. Economizer Minimum Position Setpoint Degrees (Parameter 35)
    e. Outside Air Humidity Sensor ON (Parameter 36)
    f. Economizer Outside Air Enthalpy Setpoint Btu/lb (Parameter 37)
    g. Supply Air Temperature Degrees (Parameter 65)
    h. Outside Air Temperature Degrees (Parameter 67)
    i. Outside Air Humidity Percent (Parameter 69)

3. Keypad Setpoints and Data for Dual Enthalpy Changeover

a.	Economizer	ON	(Parameter 32)
b.	Economizer 1st Stage	Degrees	(Parameter 33)
c.	Economizer 2nd Stage	Degrees	(Parameter 34)
d.	Economizer Minimum Position Setpoint	Degrees	(Parameter 35)
e.	Outside Air Humidity Sensor	ON	(Parameter 36)
f.	Return Air Humidity Sensor	ON	(Parameter 38)
g.	Supply Air Temperature	Degrees	(Parameter 65)
h.	Outside Air Temperature	Degrees	(Parameter 67)
i.	Outside Air Humidity	Percent	(Parameter 69)
j.	Return Air Humidity	Percent	(Parameter 70)

4. Inputs
    a. 10k NTC supply air temperature sensor to terminals SAT+ and SAT-
    b. 10k NTC outside air temperature sensor to terminals OAT+ and OAT-
    c. 0-10 vdc from outside air humidity sensor to terminals OH+ and OH-. Sensor only used for single and dual enthalpy changeover.
    d. 0-10 vdc from return air humidity sensor to terminals RH+ and RH-. Sensor only used for dual enthalpy changeover.
5. Outputs
    a. 2-10 vdc from ECO+ and ECO- to economizer actuator
6. Operation
    a. With a demand for first stage cooling either from a thermostat or space sensor and outside air suitable for free cooling, the dampers will be modulated to maintain supply air temperature to within +/- 1 degree of the 1st Stage Economizer setpoint. If the output to the economizer actuator is at 10 vdc and the 1st Stage Economizer setpoint can not be maintained, the dampers will be modulated to bring the supply air temperature to 5 degrees higher than the setpoint and the 1st stage compressor will be energized. Economizer will be modulated to maintain supply air temperature to within +/- 1 degree of the 1st Stage Economizer setpoint. Compressors will continue to stage on in this manner. If the supply air temperature can not be raised to 5 degrees higher than setpoint, a compressor will not be energized.
    b. If a demand for second stage cooling occurs and the economizer is already modulating to maintain the 1st Stage setpoint, the setpoint will be changed to the 2nd Stage setpoint. Any compressors that are energized will remain energized and the economizer dampers will be modulated to maintain supply air temperature to within +/- 1 degree of the 2nd Stage setpoint. If the output to the economizer actuator is at 10 vdc and the 2nd Stage Economizer setpoint can not be maintained, the dampers will be modulated to bring the supply air temperature to 5 degrees higher than the setpoint and the next available compressor stage will be energized. Economizer will be modulated to maintain supply air temperature to within +/- 1 degree of the 1st Stage Economizer setpoint. Compressors will continue to stage on in this manner. If the supply air temperature can

not be raised to 5 degrees above setpoint, a compressor will not be energized.

c. 3rd and 4th stage demands have no effect when in the free cooling mode.

d. If the output to the economizer actuator is at minimum position and the supply air temperature drops more than 5 degrees below the current economizer setpoint, the highest stage compressor will be de-energized as long as the minimum run time has elapsed.

VAV Economizer

1. Keypad Setpoints and Data for Dry Bulb Changeover
   a. Economizer ON (Parameter 32)
   b. VAV Upper Cooling SAT setpoint Degrees (Parameter 23)
   c. VAV Lower Cooling SAT setpoint Degrees (Parameter 24)
   d. Economizer Minimum Position Setpoint Degrees (Parameter 35)
   e. Economizer OAT Enable Setpoint Degrees (Parameter 39)
   f. Supply Air Temperature Degrees (Parameter 65)
   g. Outside Air Temperature Degrees (Parameter 67)
2. Keypad Setpoints and Data for Single Enthalpy Changeover
   a. Economizer ON (Parameter 32)
   b. VAV Upper Cooling SAT setpoint Degrees (Parameter 23)
   c. VAV Lower Cooling SAT setpoint Degrees (Parameter 24)
   d. Economizer Minimum Position Setpoint Degrees (Parameter 35)
   e. Outside Air Humidity Sensor ON (Parameter 36)
   f. Economizer Outside Air Enthalpy Setpoint Btu/lb (Parameter 37)
   g. Supply Air Temperature Degrees (Parameter 65)
   h. Outside Air Temperature Degrees (Parameter 67)
   i. Outside Air Humidity Percent (Parameter 69)
3. Keypad Setpoints and Data for Dual Enthalpy Changeover
   a. Economizer ON (Parameter 32)
   b. VAV Upper Cooling SAT setpoint Degrees (Parameter 23)
   c. VAV Lower Cooling SAT setpoint Degrees (Parameter 24)
   d. Economizer Minimum Position Setpoint Degrees (Parameter 35)
   e. Outside Air Humidity Sensor ON (Parameter 36)
   f. Return Air Humidity Sensor ON (Parameter 38)
   g. Supply Air Temperature Degrees (Parameter 65)
   h. Outside Air Temperature Degrees (Parameter 67)
   i. Outside Air Humidity Percent (Parameter 69)
   j. Return Air Humidity Percent (Parameter 70)
4. Inputs
   a. 10k NTC supply air temperature sensor to terminals SAT+ and SAT-
   b. 10k NTC outside air temperature sensor to terminals OAT+ and OAT-
   c. 0-10 vdc from outside air humidity sensor to terminals OH+ and OH-. Sensor only used for single and dual enthalpy changeover.
   d. 0-10 vdc from return air humidity sensor to terminals RH+ and RH-. Sensor only used for dual enthalpy changeover.

5. Outputs
    a. 2-10 vdc from ECO+ and ECO- to economizer actuator

6. Operation
    a. If the control is in an occupied mode AND not in morning warm-up AND the outside air is suitable for free cooling, the economizer dampers will be modulated to control the supply air temperature to within +/- 1 degree of the current VAV supply air temperature setpoint, either VAV Lower Cooling SAT or VAV Upper Cooling SAT. If the output to the economizer actuator is at 10 vdc and the supply air temperature setpoint can not be maintained, the dampers will be modulated to bring the supply air temperature to 5 degrees higher than the setpoint and the 1st stage compressor will be energized. Economizer will be modulated to maintain supply air temperature to within +/- 1 degree of the current VAV supply air temperature setpoint. Compressors will continue to stage on in this manner. If the supply air temperature can not be raised to 5 degrees higher than setpoint, a compressor will not be energized.
    b. If the output to the economizer actuator is at minimum position and the supply air temperature drops more than 5 degrees below the current economizer setpoint, the highest stage compressor will be de-energized as long as the minimum run time has elapsed.

BAS Economizer Operation

1. Keypad Setpoints
    a. Economizer OFF (Parameter 32)
    b. Outside Air Humidity Sensor OFF (Parameter 36)
    c. Return Air Humidity Sensor OFF (Parameter 38)
    d. BAS Economizer ON (Parameter 58)
2. Inputs
    a. 2-10 vdc to terminals BAS Econo
3. Outputs
    a. 2-10 vdc from ECO+ and ECO- to economizer actuator
4. Operation
    a. A 2-10 vdc input from a 3rd party source to terminals BAS Econo generates a corresponding 2-10 vdc output from ECO+ and ECO- to the position the economizer dampers.
5. Special note – damage to the Elite control will occur if voltage is applied to BAS ECON terminals before parameter 58 is turned on.

VAV Gas and Electric Heating Functions

Morning Warm-UP

1. Keypad Setpoints and Data
    a. VAV Occupied Heating — ON (Parameter 26)
    b. Morning Warm-Up — ON (Parameter 28)
    c. Morning Warm-Up RAT setpoint — Degrees (Parameter 29)
    d. Heat Mode Enable — ON (Parameter 54)
    e. Return Air Temperature — Degrees (Parameter 66)
    f. Heat Stages — 1 to 3 (Parameter 81)
2. Inputs
    a. 10k NTC return air temperature sensor to terminals RAT+ and RAT-
    b. 24 vac to limit switch safety terminals LIM1, LIM2, and LIM3
    c. 24 vac to gas valve verification terminals GV1, GV2, and GV3
3. Outputs
    a. 24 vac for heat stages 1 through 3 from terminals H1, H2, and H3
4. Operation
    a. On a transition from unoccupied to occupied mode, the return air temperature is compared to the Morning Warm-Up RAT setpoint. If the return air temperature is more than 2 degrees below the Morning Warm-UP RAT setpoint, all heat stages will be energized with an approximate 30 second delay between stages.
    b. All heat stages will remain energized until the return air temperature reaches the Morning Warm-UP RAT setpoint at which time all heat stages will be de-energized as long as each stages minimum run time has elapsed.
    c. The control will remain in a morning warm-up mode for the programmed morning warm-up time period and will continue to monitor the return air temperature. If at any time during the morning warm-up period the return air temperature drops more than 2 degrees below the Morning Warm-Up RAT setpoint, the heat stages will be energized until the return air temperature once again reaches the Morning Warm-Up RAT temperature setpoint.

VAV Occupied Heating without Space Sensor

1. Keypad Setpoints and Data
    a. VAV Occupied Heating — ON (Parameter 26)
    b. VAV Occupied Heating setpoint — Degrees (Parameter 27)
    c. Morning Warm-Up RAT setpoint — Degrees (Parameter 29)
    d. Heat Mode Enable — ON (Parameter 54)\
    e. Return Air Temperature — Degrees (Parameter 66)
    f. Heat Stages — 1 to 3 (Parameter 81)
2. Inputs
    a. 10k NTC return air temperature sensor to terminals RAT+ and RAT-
    b. 24 vac to limit switch safety terminals LIM1, LIM2, and LIM3
    c. 24 vac to gas valve verification terminals GV1, GV2, and GV3
3. Outputs
    a. 24 vac for heat stages 1 through 3 from terminals H1, H2, and H3
4. Operation
    a. Control must be in occupied mode and not in morning warm-up
    b. If the return air temperature is more than 2 degrees below the VAV Occupied Heating setpoint, all heat stages will be energized with an approximate 30 second time delay between stages
    c. Heat will remain energized until the return air temperature reaches the VAV Morning Warm-Up RAT setpoint.
5. Special Notes
    a. VAV Morning Warm-Up RAT setpoint must be equal to or greater than VAV Occupied Heating setpoint.

VAV Occupied Heating with Space Sensor

1. Keypad Setpoints and Data
    a. VAV Occupied Heating — ON (Parameter 26)
    b. VAV Occupied Heating setpoint — Degrees (Parameter 27)
    c. Morning Warm-Up RAT setpoint — Degrees (Parameter 29)
    d. Heat Mode Enable — ON (Parameter 54)
    e. Return Air Temperature — Degrees (Parameter 66)
    f. Space Temperature Sensor — Degrees (Parameter 68)
    g. Heat Stages — 1 to 3 (Parameter 81)
2. Inputs
    a. 10k NTC return air temperature sensor to terminals RAT+ and RAT-
    b. 10k NTC space temperature sensor to terminals ST and GND
    c. 24 vac to limit switch safety terminals LIM1, LIM2, and LIM3
    d. 24 vac to gas valve verification terminals GV1, GV2, and GV3
3. Outputs
    a. 24 vac for heat stages 1 through 3 from terminals H1, H2, and H3
4. Operation
    a. Control must be in an occupied mode and not in morning warm-up
    b. If the space temperature drops 2 degrees below the VAV Occupied Heating setpoint AND the return air temperature is below the Morning

Warm-Up RAT setpoint, all heat stages will be energized with an approximate 30 second delay between stages.

c. Heat will remain energized until return air temperature reaches the morning Warm-Up setpoint.
d. Heat will continue to cycle on and off based on the Morning Warm-Up RAT setpoint until the space temperature reaches the VAV Occupied Heating setpoint.

Constant Volume

Staging Control Without a Space Sensor

1. Keypad Setpoints and Data

a.	Occupied Cooling setpoint	Degrees	(Parameter 10)
b.	Occupied Heating setpoint	Degrees	(Parameter 11)
c.	Unoccupied Cooling setpoint	Degrees	(Parameter 12)
d.	Unoccupied Heating setpoint	Degrees	(Parameter 13)
e.	Cooling Mode Enable	ON	(Parameter 53)
f.	Heating Mode Enable	ON	(Parameter 54)
g.	Return Air Temperature	Degrees	(Parameter 66)
h.	Compressors	2-4	(Parameter 80)
i.	Heat Stages	0-3	(Parameter 81)

2. Inputs
   a. 10k NTC return air temperature sensor to terminals RAT+ and RAT-
   b. 24 vac to limit switch safety terminal LIM1, LIM2, and LIM3
   c. 24 vac to gas valve verification terminals GV1, GV2, GV3
   d. 24 vac to C10, C20, C30, and C40 from compressor protection modules
   e. 24 vac to HPS1 through HPS4 and to LPS1 through LPS4
3. Outputs
   a. 24 vac from C1, C2, C3, and C4 compressor outputs
   b. 24 vac from CF1 and CF2 condenser fan outputs
   c. 24 vac for heat stages 1 through 3 from terminals H1, H2, and H3
4. Operation
   a. Compressors are staged on and off based on return air temperature compared to the operating cooling setpoint, either Occupied Cooling or Unoccupied Cooling
   b. Heat is staged based on return air temperature compared to operating heating setpoint, either Occupied Heating or Unoccupied Heating.
5. Special Notes
   a. Occupied/Unoccupied times are determined either by the clock and schedule programmed in the Elite control or by a 24 vac input to the OCC terminal
   b. If 24 vac to the OCC terminal is used, Parameter 71 must be turned ON.

Staging Control with Space Sensor

1. Keypad Setpoints and Data
    a. Occupied Cooling setpoint — Degrees (Parameter 10)
    b. Occupied Heating setpoint — Degrees (Parameter 11)
    c. Unoccupied Cooling setpoint — Degrees (Parameter 12)
    d. Unoccupied Heating setpoint — Degrees (Parameter 13)
    e. Cooling Mode Enable — ON (Parameter 53)
    f. Heating Mode Enable — ON (Parameter 54)
    g. Space Temperature — Degrees (Parameter 68)
    h. Compressors — 2-4 (Parameter 80)
    i. Heat Stages — 0-3 (Parameter 81)
2. Inputs
    a. 10k NTC space temperature sensor to terminals ST and GND
    b. 24 vac to limit switch safety terminal LIM1, LIM2, and LIM3
    c. 24 vac to gas valve verification terminals GV1, GV2, GV3
    d. 24 vac to C10, C20, C30, and C40 from compressor protection modules
    e. 24 vac to HPS1 through HPS4 and to LPS1 through LPS4
    f. Outputs
    a. 24 vac from C1, C2, C3, and C4 compressor outputs
    b. 24 vac from CF1 and CF2 condenser fan outputs
    c. 24 vac for heat stages 1 through 3 from terminals H1, H2, and H3
3. Operation
    a. Compressors are staged on and off based on space temperature compared to the operating cooling setpoint, either Occupied Cooling or Unoccupied Cooling
    b. Heat is staged based on space temperature compared to operating heating setpoint, either Occupied Heating or Unoccupied Heating.
4. Special Notes
    a. Occupied/Unoccupied times are determined either by the clock and schedule programmed in the Elite control or by a 24 vac input to the OCC terminal
    b. If 24 vac to the OCC terminal is used, Parameter 71 must be turned ON

Staging Control using a Wall Thermostat

1. Keypad Setpoints and Data
    a. Occupied Cooling setpoint — Degrees (Parameter 10)
    b. Occupied Heating setpoint — Degrees (Parameter 11)
    c. Unoccupied Cooling setpoint — Degrees (Parameter 12)
    d. Unoccupied Heating setpoint — Degrees (Parameter 13)
    e. Cooling Mode Enable — ON (Parameter 53)
    f. Heating Mode Enable — ON (Parameter 54)
    g. Compressors — 2-4 (Parameter 80)
    h. Heat Stages — 0-3 (Parameter 81)

2. Inputs
    a. 24 vac to limit switch safety terminal LIM1, LIM2, and LIM3

   b. 24 vac to gas valve verification terminals GV1, GV2, GV3
   c. 24 vac to C10, C20, C30, and C40 from compressor protection modules
   d. 24 vac to HPS1 through HPS4 and to LPS1 through LPS4
   e. 24 vac to Y1 through Y4, W1 through W3, G
3. Outputs
   a. 24 vac from C1, C2, C3, and C4 compressor outputs
   b. 24 vac from CF1 and CF2 condenser fan outputs
   c. 24 vac for heat stages 1 through 3 from terminals H1, H2, and H3
4. Operation
   a. Cooling stages are energized by 24 vac inputs from the thermostat to terminals Y1, Y2, Y3, and Y4
   b. Heating Stages are energized by 24 vac inputs from the thermostat to terminals W1, W2, and W3
   c. Fan is energized with 24 vac input from thermostat to terminal G
5. Special Notes
   a. When a wall thermostat is used, the occupied/unoccupied times are programmed in the thermostat.
   b. Occupied and unoccupied cooling setpoints must be set at 99. Otherwise, cooling stages could be energized by the return air temperature sensor
   c. Occupied and unoccupied heating setpoints must be set at 45. Otherwise, heating stages could be energized by the return air temperature sensor.

Demand Ventilation

1. Keypad Setpoints

a.	Economizer	ON	(Parameter 32)
b.	Demand Ventilation	ON	(Parameter 40)
c.	IAQ Sensor Range	ppm	(Parameter 41)
d.	Demand Ventilation Setpoint	ppm	(Parameter 42)

2. Inputs
   a. 0-10 vdc from CO_2 sensor to terminals DV+ and DV-
3. Outputs
   a. 2-10 vdc from ECO+ and ECO-
4. Operation
   a. Modulates economizer dampers to maintain Demand Ventilation Setpoint +/-100 ppm
   b. If space CO_2 level exceeds Demand Ventilation setpoint by more than 100 ppm, OA dampers are driven open until CO_2 level is less than 100 ppm above the Demand Ventilation setpoint. As long as CO_2 level stays within 100 ppm of setpoint, OA damper position is held.
   c. If space CO_2 level drops more than 100 ppm below the Demand Ventilation setpoint, OA dampers will be driven closed until CO_2 level is within 100 ppm of setpoint. As long as CO_2 level stays within 100 ppm of setpoint, OA damper position is held.
   d. If free cooling economizer position exceeds the demand ventilation position, economizer OA dampers will be driven open further.

e. While in demand ventilation, if SAT drops below 45 degrees F the control will modulate economizer OA dampers closed until SAT rises above 50 degrees F and will continue to maintain SAT at 50 degrees F.
f. While in demand ventilation, if SAT rises above 90 degrees F the control will modulate economizer OA dampers closed until SAT drops below 85 degrees F and will continue to maintain SAT at 85 degrees F.
g. Demand ventilation overrides the economizer free cooling position.

Hydronic Heat

Constant Volume

1. Keypad Setpoints and Data

a.	Occupied Heating setpoint	degrees	(Parameter 11)
b.	Unoccupied Heating setpoint	degrees	(Parameter 13)
c.	Hydronic Heat	ON	(Parameter 18)
d.	Stage 1 Hydronic Heat setpoint	degrees	(Parameter 19)
e.	Stage 2 Hydronic Heat setpoint	degrees	(Parameter 20)
f.	Hydronic Heat Reverse Actuated Valve	ON/OFF	(Parameter 21)
g.	Heat Mode enable	ON	(Parameter 54)
h.	Supply Air Temperature	degrees	(Parameter 66)
i.	Outside Air Temperature	degrees	(Parameter 67)
j.	Return Air Temperature	degrees	(Parameter 68)

2. Inputs
   a. 10k NTC supply air temperature sensor to terminals SAT+ and SAT-
   b. 10k NTC return air temperature sensor to terminals RAT+ and RAT-
   c. 10k NTC outside air temperature sensor to terminals OAT+ and OAT-
   d. 10k NTC space temperature sensor to terminals ST and GND
   e. 24 VAC to W1 and W2 if wall thermostat installed
3. Outputs
   a. 2-10 vdc from HWV+ and HWV-
4. Operation
   a. With a 1st stage heat demand the hot water valve is modulated to maintain SAT to the Stage 1 Hydronic Heat setpoint +/- 1 degree
   b. With a 2nd stage heat demand the hot water valve is modulated to maintain SAT to the Stage 2 Hydronic Heat setpoint +/- 1 degree
5. Special note – supply air temperature must be relocated in the field to a position on the leaving air side of the hydronic call

VAV

1. Keypad Setpoints and Data
    a. Hydronic Heat ON (Parameter 18)
    b. Stage 2 Hydronic Heat setpoint degrees (Parameter 20)
    c. Hydronic Heat Reverse Actuated Valve ON/OFF (Parameter 21)
    d. VAV Occupied Heating ON/OFF (Parameter 26
    e. VAV Occupied Heating setpoint degrees (Parameter 27)
    f. Morning Warm-up ON/OFF (Parameter 28)
    g. Morning Warm-up RAT setpoint degrees (Parameter 29)
    h. Heat Mode enable ON (Parameter 54)
    i. Supply Air Temperature degrees (Parameter 66)
    j. Outside Air Temperature degrees (Parameter 67)
    k. Return Air Temperature degrees (Parameter 68)
2. Inputs
    a. 10k NTC supply air temperature sensor to terminals SAT+ and SAT-
    b. 10k NTC return air temperature sensor to terminals RAT+ and RAT-
    c. 10k NTC outside air temperature sensor to terminals OAT+ and OAT-
    d. 10k NTC space temperature sensor to terminals ST and GND
    e. 24 vac to W1 in unoccupied mode only
3. Outputs
    a. 2-10 vdc from HWV+ and HWV-
4 Operation
    a. A heating demand must be generated in one of the following ways:
        i. Morning warm-up based on RAT
        ii. VAV occupied heating based on either RAT or ST
        iii. Unoccupied heating with 24 vac input to W1
    b. Hot water valve is modulated to control SAT to the Stage 2 Hydronic Heat setpoint
    c. Stage 1 Hydronic Heat setpoint is not used on VAV units
5. Special note – supply air temperature sensor must be relocated in the field to a position on the leaving air side of the hydronic coil