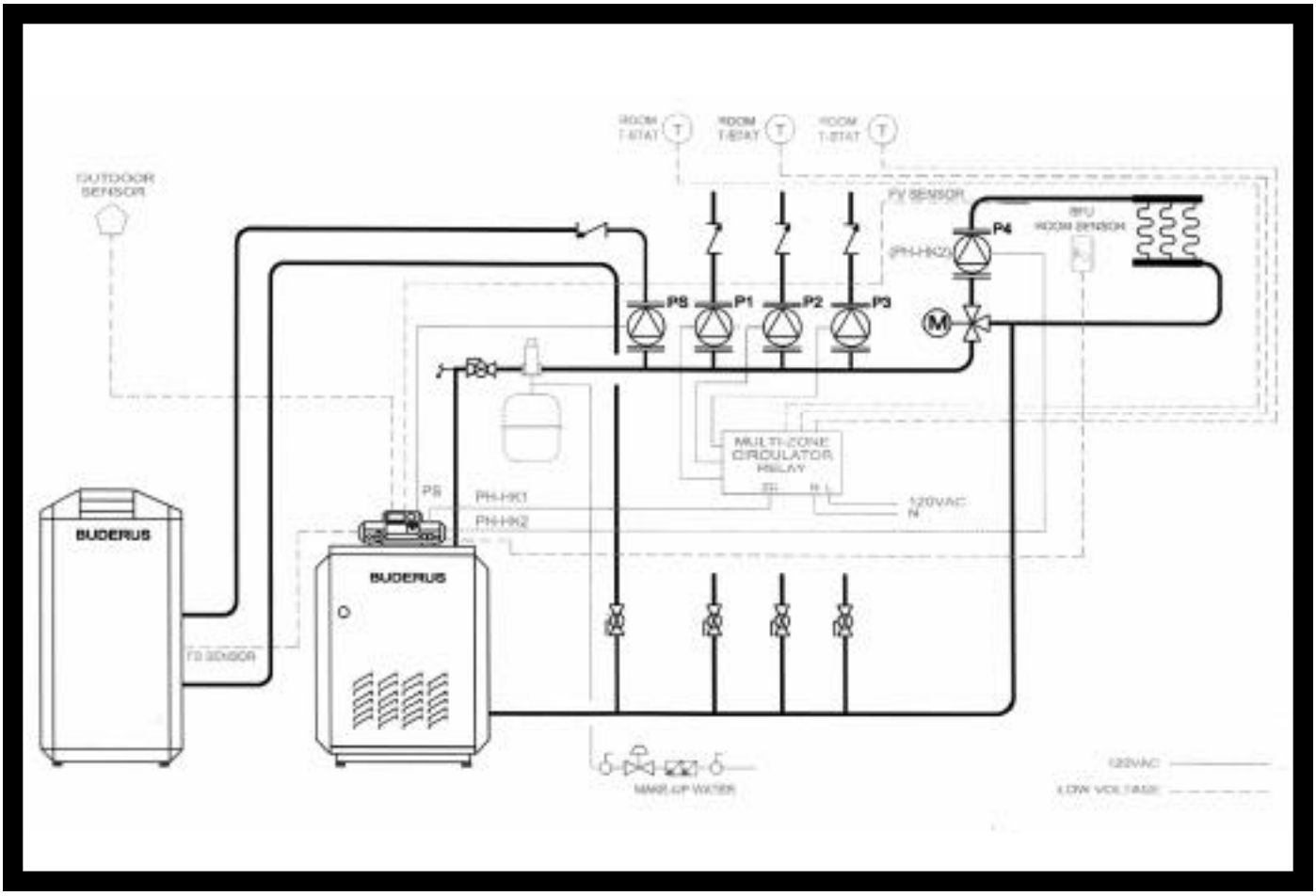
Buderus
HYDRONIC SYSTEMS

Applications Manual

Ecomatic / Logamatic Controls



Save These Instructions !

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Introduction 1

This manual is intended to address some of the many applications that are possible using Buderus outdoor reset controls. Applications depicted in the manual are presented with both mechanical and electrical outlines. The drawings contained in this manual are intended to be used as an aid to system installers and designers and are conceptual in nature. Auxiliary equipment depicted in this manual does not necessarily represent any one particular manufacturer or specific model number. There are a wide variety of techniques, practices and piping arrangements possible with hydronic heating systems and it is the responsibility of the installing contractor to determine which of these is best suited for a specific application.

In an effort to simplify electrical drawings, they have been limited to zone controlling only (space heating and DHW). Other constants such as power input, boiler sensor and outdoor sensor wiring have also been eliminated. Information for wiring of burners and constants can be found in section 5 of this manual. Further information can be found in the control service manual.

Although this manual covers many common applications for our equipment, the possibilities are virtually endless. Should you encounter an application that is not covered in this manual or have questions regarding any of its content, we encourage you to contact us here at Buderus Hydronic Systems, USA.

Buderus Hydronic Systems, Inc. reserves the right to make changes without notice due to continuing engineering and technological improvements.

2 Terms

Outdoor Reset: Outdoor reset is a control method that takes outdoor air temperature into consideration when determining the system water temperature. Instead of a fixed high limit temperature (i.e. 180°), the high limit is reset to a temperature high enough to satisfy the heat loss at any given outdoor temperature.

In designing a heating system the first requirement is an accurate heat loss calculation. Several factors are used in determining heat loss, the volume of space being heated, type of materials being used in construction, insulation values and a design temperature. The design temperature represents the coldest day of the year. The heat loss calculation is then used to determine the output requirements for the boiler, baseboard, panel radiators, etc. In short the system is sized to heat your house on the coldest day of the year.

However, a buildings heat loss is ever changing; and is largely dependent on outdoor temperature. As the outdoor temperature drops, your heat loss increases and as it rises your heat loss decreases. The fact is that approximately 98% of the heating season your boiler and radiators are oversized. With outdoor reset controlling you can more accurately match the output from your heating system to the current heat loss. For example, you may require 180° water temperature circulating through your system in order to have enough output to maintain a 70° indoor temperature on a 10° day. Yet, at a 40° outdoor temperature you may only require 135° water temperature to satisfy the heat loss. By resetting the system water temperature, a lower average water temperature is used throughout the heating season and maximum temperature is used only on the coldest days of the year.

Among the many benefits to this type of controlling is optimum fuel economy. By only heating the water to the minimum temperature needed, fuel economy is maximized (as much as 30% in fuel savings!). Lower standby losses during “off” cycles (due to a lower boiler temperature) also reduce fuel consumption. In addition, room comfort level is significantly increased by matching the heat output to the current heat loss. Less room temperature fluctuation is realized. System noise caused by expansion of piping is significantly reduced due to lower system water temperatures.

Constant circulation zone: A constant or continuous circulation zone is just what the term implies, water continuously circulates through a given zone when the heating system is in operation. The water temperature in this zone is modulated so that the heat output from your distribution units (i.e., fin-tube baseboard, panel radiators, radiant floors, etc.) matches the rate of heat loss for that zoned area. A constant circulation zone is typically the main heating zone. In multi-zone systems, the constant circulation zone must require the highest system water temperature. With this method of controlling, a room sensor is required in order to monitor room temperature. All secondary zones will have standard room thermostats to intermittently operate a zone valve or zone circulator.

The constant circulation zone will only be interrupted under the following conditions:

- Domestic hot water priority.
- Certain setback modes (See the control Service Manual for information on various setback modes).
- Condensate protection. If boiler water temperature falls below the condensate protection temperature while the burner is firing, the space heating circulator(s) will be shut off. Once the boiler temperature reaches a safe level, circulator operation will resume.
- When the outdoor temperature rises above the WWSD (warm weather shut down) setting.

WWSD: Warm weather shut down or summer-winter changeover, is the outdoor air temperature at which the space heating function of the system shuts down. With the Buderus control system this temperature is adjustable from 49°F to 87°F. When the outdoor temperature rises above the WWSD set point, the system will only operate for domestic hot water production. . (For detailed operation of the WWSD feature refer to the control Service Manual).

BFU Room sensor: The Buderus room sensor is similar to a thermostat although it will not turn a circulator on or off. The function of the room sensor is to continually monitor room temperature and relay this information back to the control system. This information is used to compensate for variations in room temperature due to internal heat gains (or losses) such as solar gain, fireplaces, wood stoves, appliances, lighting, people, open doors or windows, etc. The control compensates for these variations by adjusting the system water temperature (up or down) in order to maintain the desired room temperature. Buderus room sensors also allow the occupant to manually override programmed setback periods.

The control system allows you to limit the amount of compensation that the room sensor has over the selected heating curve. This setting is referred to as “ROOM COMP” and can be adjusted at the programming level of the control. This setting is only available when using a room sensor.

You may want to limit compensation if secondary zones are under radiated.
Example: The main heating zone (continuous circulation) zone is experiencing solar heat gain. The room sensor senses the rise in room temperature and lowers the system water temperature in order to keep the zone from over heating. In this scenario, the system water temperature could be lowered enough so that the output from a secondary zone was insufficient to satisfy that zone.

Only one Buderus room sensor can be used for high temperature space heating (a second room sensor can be added when using an FM241 module for motorized mixing of a lower water temperature).

Careful consideration must be given to placement of room sensors. Keep in mind that not all applications are suitable for using a constant circulation zone. Avoid using a room sensor in a small baseboard zone as overheating may occur during DHW production. A standard room thermostat can be used in conjunction with the room sensor to give high limit protection.

2 Terms

Setback: Buderus reset controls allow the occupant to program setback periods in order to further reduce operating costs. Several modes of setback can be selected with the Buderus control. The two modes used for residential applications are “SETBACK” and “RMSETBACK”. Unlike conventional setback thermostats that only reduce the zone temperature setting, the Buderus control system will operate the boiler at a reduced water temperature. For example, at a 30°F outdoor temperature the boiler water temperature may be 145°F, at that same 30° outdoor temperature during a setback period, the boiler water temperature may be reduced to 130°.

This further reduction of water temperature will decrease the output from your radiators thereby lowering the room temperature in the living space. The extent to which the water temperature is reduced is dependent upon the desired room temperature reduction during setback periods. This value can be set in one of two ways:

- SETBACK mode - a “DAYTEMP” and a “NIGHTTEMP” would be entered on the Buderus control (this would be done when you are not using a BFU room sensor).

- RMSETBACK mode - when using a BFU room sensor, the room sensor allows you to select the amount of room temperature setback.

Allowance for pick-up time must be considered when coming out of a setback period. Systems that operate on outdoor reset will have a longer recovery time than systems that operate at maximum temperatures all the time. The two variables to consider are the amount of room temperature reduction and the length of the setback period. The use of a BFU room sensor can speed up the recovery time, however the amount of temperature boost is dependent upon the ROOMCOMP setting on the Buderus control (for details refer to the control Service Manual).

Description of Wiring Terminals 3

WHITE	WHITE	ORANGE	GREEN		YELLOW/BLUE	GREEN	GREY	PURPLE
POWER OUTPUT	POWER INPUT	SAFETY LIMIT	BURNER		FLUE GAS	HEAT PUMP	DHW PUMP	RECIRC PUMP
ZM 1	Netz	SI-Gerate	Brenner		Abgasuberwachung	PH-HK1	PS	PWF
⏚ N L	⏚ N L	17 18 19	⏚ 4 8 9 10 11 12		⏚ N 1 2 3 4	N H ⏚ 61 63	N H ⏚ 24 25	N H ⏚ 13 14

BROWN	TAN	GREEN	BLUE
ROOM SENSOR	TANK SENSOR	BOILER SENSOR	OUTDOOR SENSOR
BF	FB	FK	FA
1 2	1 2	1 2	1 2

Line Voltage (120-VAC) Connections:

White (ZM1)

Constant 120-vac power:
Used to supply line voltage power when using optional module FM241. The wiring harness on the FM241 module plugs into this block. If a 110V motor is being operated by the FM241, connect ZM 1 to terminal 41 on the SH-HK2 wiring block.

White (Netz)

Power input:
Connect 120-vac power source to L and N using 10 amp in-line fuse provided.

Orange (SI)

Safety connections:

Terminals 17 and 18: There is a factory-installed jumper between terminals 17 and 18. This jumper must stay in place unless a 120v low-water cutoff is used. When using a low-water cutoff, remove the jumper and connect the normally closed contacts on the low-water cutoff to terminals 17 and 18.

Terminal 19: When the manual reset high-limit trips, terminal 19 puts out 120-vac for alarm signal (alarm provided by others).

Green (Brenner)

Burner connection:

Terminal 4: Common neutral
Terminal 8: Requires 120-vac input to operate the hours run meter
Terminal 9: Requires 120-vac input to display burner error
Terminal 10 and 11: Dry contact closure for burner firing
Terminal 12: Constant 120-vac voltage

(See section 5 of this manual for application wiring diagrams for burner circuit)

Yellow/Blue (UE)

Flue gas testing:
Not used in U.S. ***Do not*** remove factory installed jumper between terminals 2 and 3.

Green (HK-1)

Space heating circuit #1:
120-vac power output on terminals 61 (N) and 63 (H) for space heating pump(s). Not to exceed 5 amp draw. If multiple space-heating pumps are used, refer to specific application wiring diagrams provided in this manual (section 6).

Grey (PS)

Domestic water circulator:
120-vac power output on terminals 24(N) and 25(H) for DHW production.

Purple (PWF)

Domestic water recirculation pump:
120-vac power output on terminals 13(N) and 14(H) for DHW recirculation.

Note: Power to terminals 61 and 63 are interrupted when the system is in domestic water production. Therefore, there will never be power on terminals 24/25 and 61/63 at the same time, while operating in automatic mode

Description of Wiring Terminals 3

WHITE	WHITE	ORANGE	GREEN		YELLOW/BLUE	GREEN	GREY	PURPLE
POWER OUTPUT	POWER INPUT	SAFETY LIMIT	BURNER		FLUE GAS	HEAT PUMP	DHW PUMP	RECIRC PUMP
ZM 1	Netz	Si-Gerate	Brenner		Abgasuberwachung	PH-HK1	PS	PWF
⏚ N L	⏚ N L	17 18 19	⏚ 4 8 9 10 11 12		⏚ N 1 2 3 4	N H ⏚ 61 63	N H ⏚ 24 25	N H ⏚ 13 14

BROWN	TAN	GREEN	BLUE
ROOM SENSOR	TANK SENSOR	BOILER SENSOR	OUTDOOR SENSOR
BF	FB	FK	FA
1 2	1 2	1 2	1 2

Sensor Connections (Low Voltage):

Brown (BF)

BFU room sensor-circuit #1:
Connect BFU room sensor (circuit #1) using 18-2 AWG wire. Connections are polarity sensitive, terminal 1 must be wired to terminal 1 on room sensor, etc. Wiring can be run up to 500′ from control.

Tan (FB)

Domestic tank sensor:
The FB tank sensor and terminal plug are supplied with the control. For SU and ST series tanks the FB sensor is inserted into the immersion well in the tank. For L and LT series the sensor is surface mounted on the front of the tank using the bracket provided on the tank. Sensor wire can be extended if necessary, using 18 AWG wire.

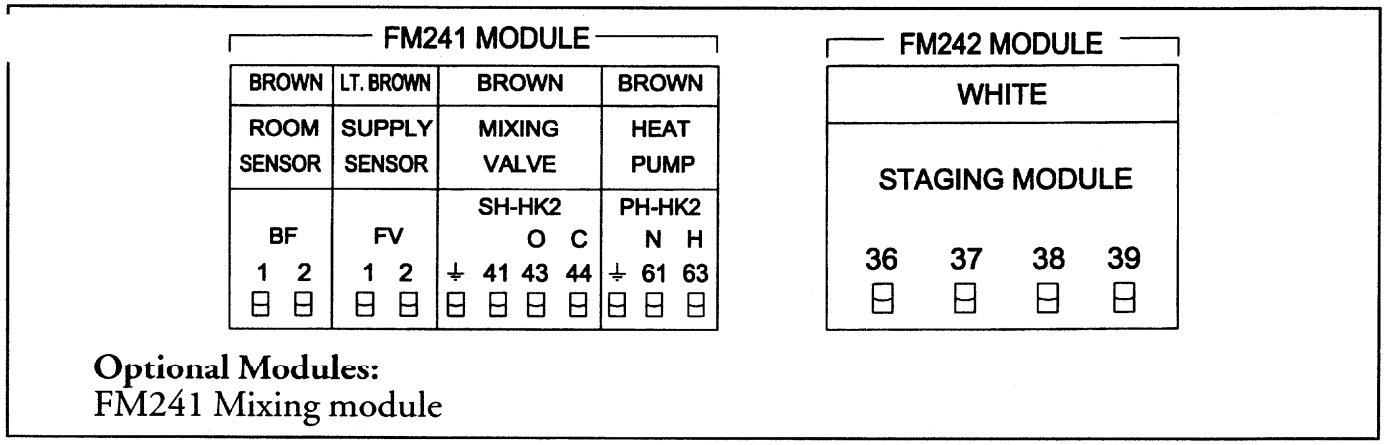
Green (FK)

Boiler sensor:
The FK sensor comes pre-wired to the terminal block and bundled together with two capillaries. This sensor bundle is inserted into the chrome well provided. (refer to control Service Manual for well location for specific boiler model)

Blue (FA)

Outdoor sensor:
The outdoor sensor is a thermistor-type sensor protected by a UV resistant enclosure. The outdoor sensor should be installed on the north/northeast side of the building, out of direct sunlight. Mount the sensor at a height where it cannot be tampered with or affected by snow accumulation. Run 18-2 AWG wire to the outdoor sensor up to 300′ in length. Avoid running wire parallel to telephone or line voltage wires.

3 Description of Wiring Terminals



Optional Modules:
FM241 Mixing module

Brown (SH/PH-HK2) Mixing/Space heating circuit #2:

Terminal 41	Power input for mixing motor
Terminal 43	"OPEN" output to mixing motor
Terminal 44	"CLOSE" output to mixing motor
Terminals 61/63	Power output for circuit #2 pump(s)(2 amp max)

(refer to section 7 of this manual for detailed wiring information for FM241)

Brown (BF) BFU room senor-circuit #2
Connect BFU room sensor (circuit #2) using 18-2 AWG wire. Connections are polarity sensitive, terminal 1 must be wired to terminal 1 on room sensor, etc. Wiring can be run up to 500′ from control.

Light Brown (FV) Mixed circuit sensor:
The FV sensor and terminal plug are supplied with the FM241 module. The FV sensor is strapped onto circuit #2 piping, for sensing of the mixed water temperature mount to piping using the spiral spring and clip provided and cover with pipe insulation. The sensor leads can be extended if necessary, using 18-2 AWG wire.

Wiring Harness Power Supply:
Connect the wiring harness attached to the FM241 module (brown, blue, and yellow/green wires) to wiring block ZM 1 on the control.

FM242 Staging Module

White

Terminal 36	Not used.
Terminal 37/39	Dry contact closure for firing of stage 2.
Terminal 38	Output signal for modulating burners only.

(refer to section 5 of this manual for detailed wiring information for FM242)

4 Application Drawings

Boiler/Burner Wiring

In order to simplify electrical application drawings, boiler/burner wiring has been omitted from this section. Detailed wiring schematics for oil burners, G124X, G234X and G334X gas boilers are located in section 5.

Mechanical/Electrical Symbols


4-Way Mixing Valve


3-Way Mixing Valve

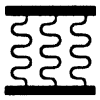

Circulator


Flow Check/ Check Valve


Ball Valve

Motor


Drain

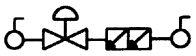

Radiant Floor Panel


Expansion Tank

Zone Valve

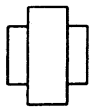

Air Eliminator

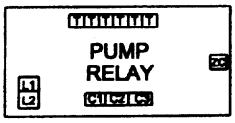

Radiation


Back Flow/ Fill Reg


Outdoor Sensor

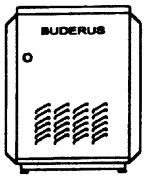
Room Thermostat


24 VAC Transformer

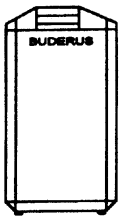


Multi-Zone Pump Relay


Temp Gauge

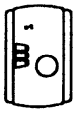


Boiler

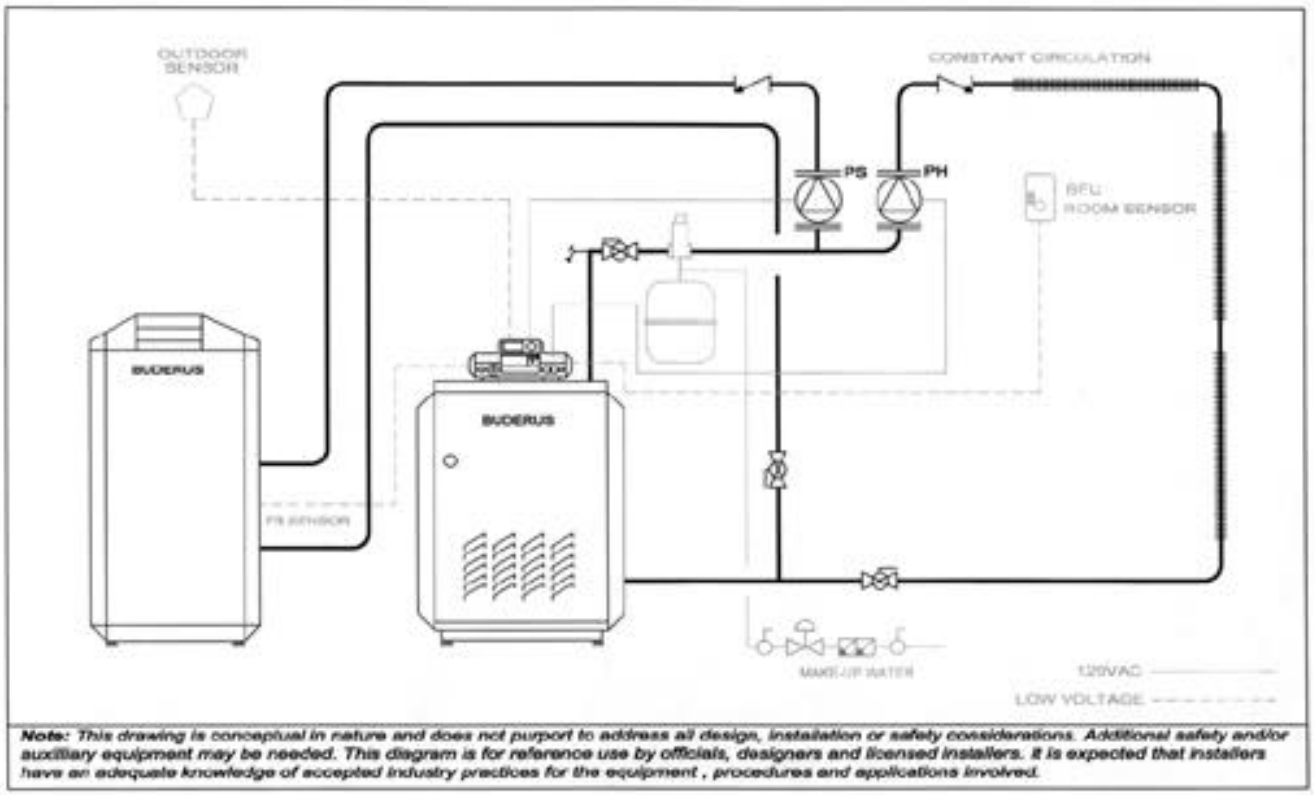


Indirect DHW Tank


Ecomatic Control


BFU Room Sensor

4 Application Drawings



APPLICATION ECO-001 / MECHANICAL

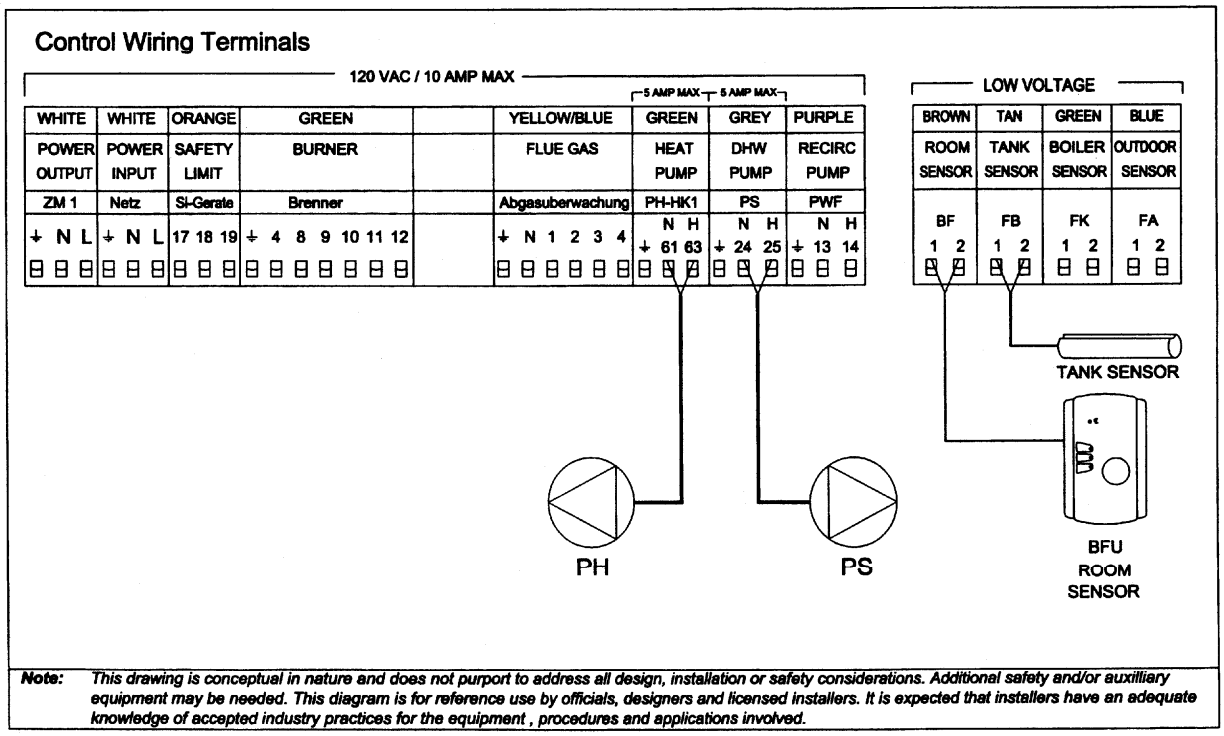
DESCRIPTION:
Single Zone Space Heating (constant circulation) / Indirect DHW Heating

Space Heating Operation:

- Boiler temperature is maintained based on the selected heating curve and inputs from both the outdoor sensor and indoor room sensor.
- During setback periods, the boiler temperature will be reduced based on the night setback setting on the room sensor.
- The space heating pump (PH) shall run continuously with the following exceptions:
  1) DHW priority
  2) Condensate protection
  3) Outdoor temperature exceeds WWSD setpoint
  4) Initial part of setback period
- This application requires a room sensor for constant circulation.

DHW Heating Operation:

- The boiler temperature rises on a call for DHW for fast recovery.
- The control powers the domestic pump (PS) and the heating circuit (PH) is shut down.
- After the DHW recharging and intelligent purge cycle is completed, the PS pump will be shut down and PH circuit will be turned on.



Note: *This drawing is conceptual in nature and does not purport to address all design, installation or safety considerations. Additional safety and/or auxilliary equipment may be needed. This diagram is for reference use by officials, designers and licensed installers. It is expected that installers have an adequate knowledge of accepted industry practices for the equipment , procedures and applications involved.*

APPLICATION ECO-001 / ELECTRICAL

DESCRIPTION:

Single Zone Space Heating (constant circulation) / Indirect DHW Heating

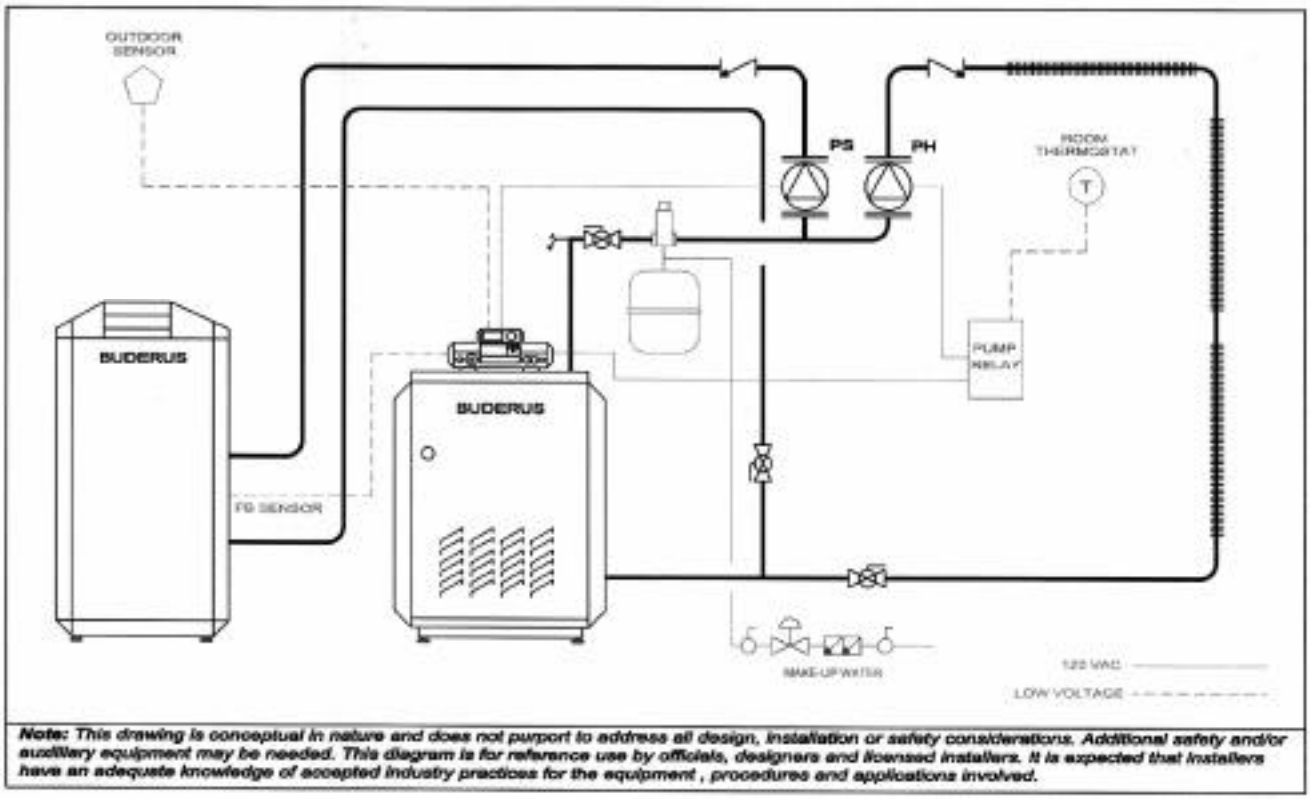
Space Heating Operation:

- Boiler temperature is maintained based on the selected heating curve (REF TEMP and OFFSET) and inputs from the outdoor sensor (FA) , boiler sensor (FK) and room sensor (BF).
- 120v output from terminals 61 & 63 (PH-HK1) powers space heating pump (PH).
- The space heating pump (PH) shall run continuously with the following exceptions:
  1) DHW priority
  2) Condensate protection
  3) Outdoor temperature exceeds WWSD setpoint
  4) Initial part of setback period
- This application requires a room sensor for constant circulation.

DHW Heating Operation:

- The tank sensor (FB) monitors domestic water temperature.
- 120v output from terminals 24 & 25 (PS) powers the DHW pump.
- During a call for DHW production the domestic pump (PS) is turned on and the space-heating pump (PH) is turned off.
- After the DHW recharging and intelligent purge cycle is completed, the PS pump will be shut down and PH circuit will be turned on.

4 Application Drawings



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APPLICATION ECO-002 / MECHANICAL

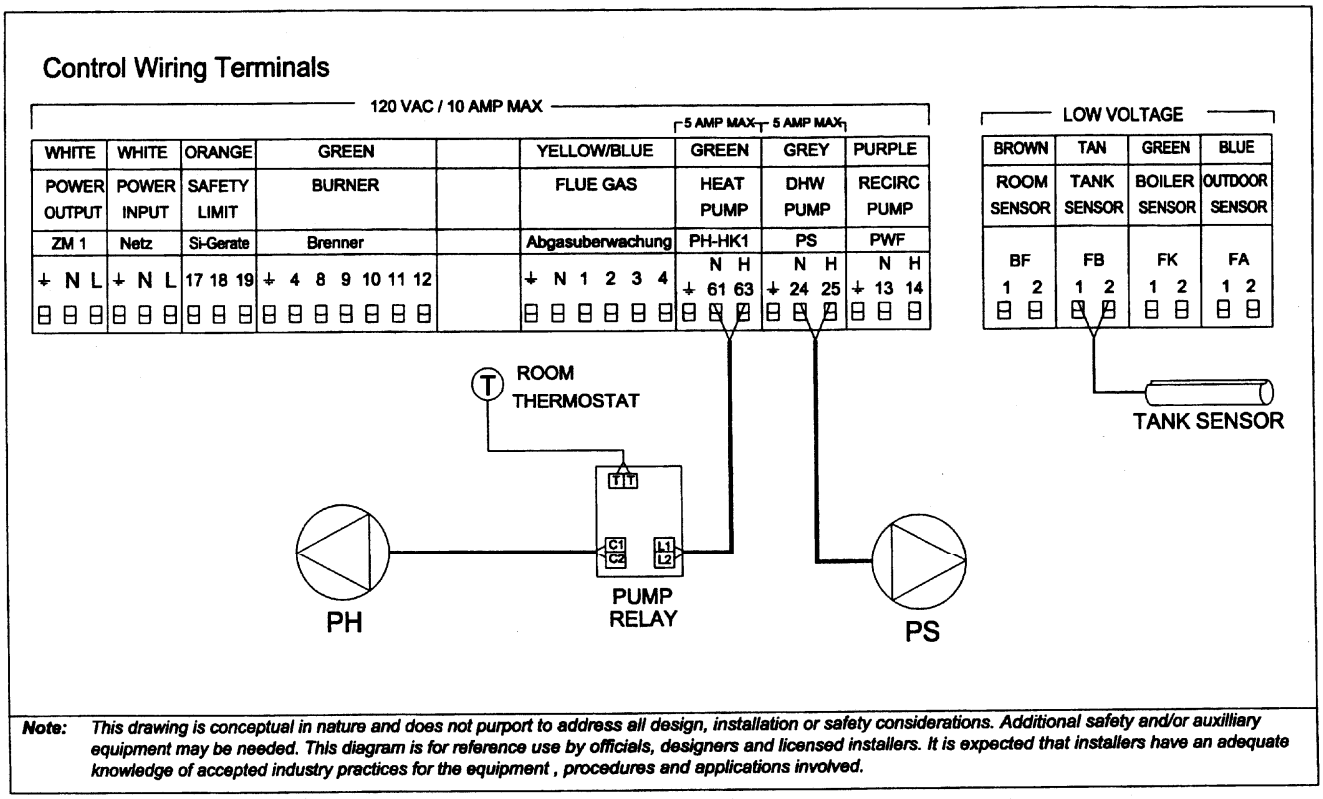
DESCRIPTION:
Single Zone Space Heating / Indirect DHW Heating

Space Heating Operation:

- Boiler temperature is maintained based on the selected heating curve and input from the outdoor sensor.
- During setback periods, the boiler temperature will be reduced based on the DAY TEMP and NIGHT TEMP settings on the Ecomatic control.
- The space-heating pump (PH) requires a switching relay to operate on a call for heat from a room thermostat.
- Power to the PH circuit shall be interrupted under the following exceptions:
  1) DHW priority
  2) Condensate protection
  3) Outdoor temperature exceeds WWSD setpoint
- This application *does not* require a room sensor.

DHW Heating Operation:

- The boiler temperature rises on a call for DHW for fast recovery.
- The control powers the domestic pump (PS) and the heating circuit (PH) is shut down.
- After the DHW recharging and intelligent purge cycle is completed, the PS pump will be shut down and PH circuit will be turned on.



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APPLICATION ECO-002 / ELECTRICAL

DESCRIPTION:
Single Zone Space Heating / Indirect DHW Heating

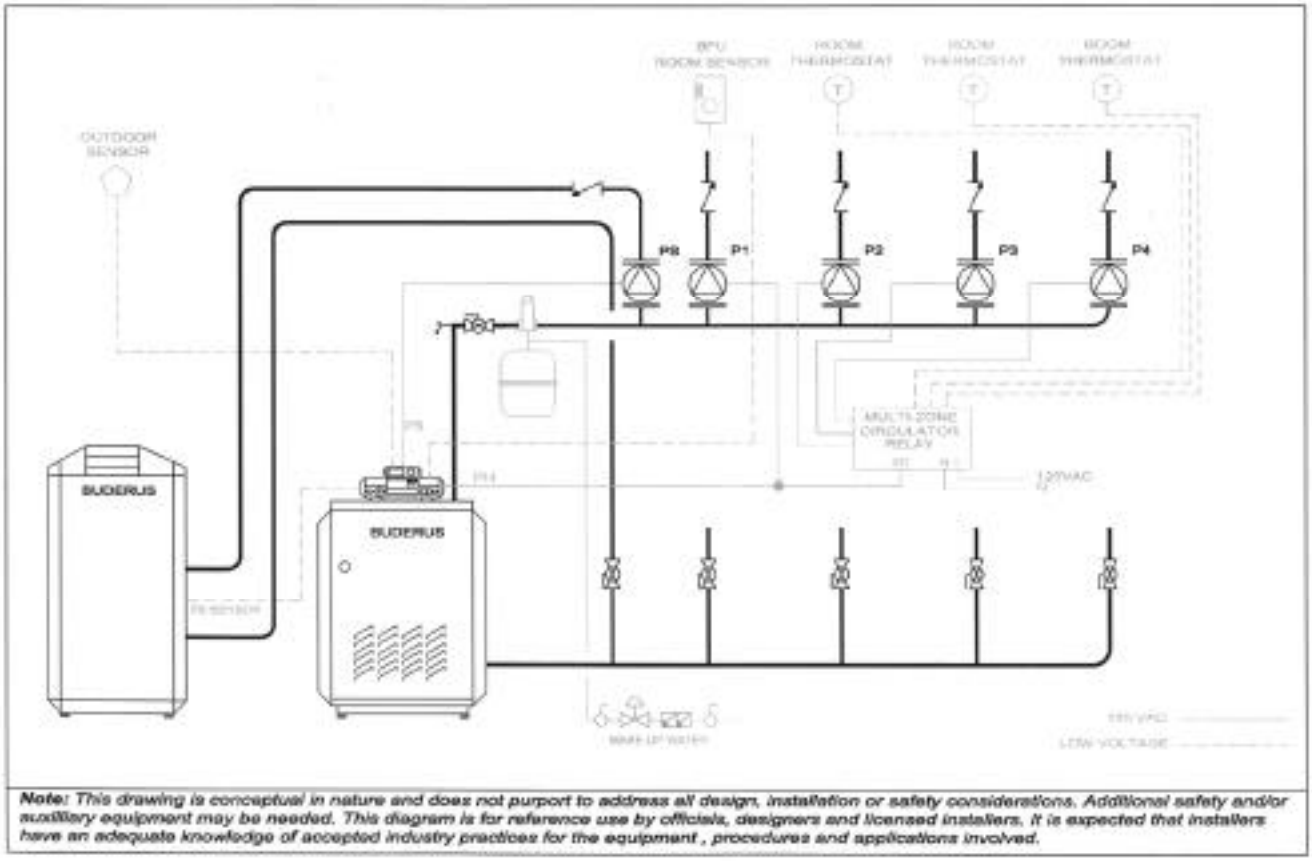
Space Heating Operation:

- Boiler temperature is maintained based on the selected heating curve (REF TEMP and OFFSET) and inputs from the outdoor sensor (FA) and boiler sensor (FK).
- This application requires a pump switching relay (not supplied by Buderus).
- 120v output from terminals 61 & 63 (PH-HK1) provides power to the pump relay. Space heating pump (PH) is energized on a call for heat from a room thermostat. Power to the pump relay shall be interrupted under the following conditions:
  1) DHW priority
  2) Condensate protection
  3) Outdoor temperature exceeds WWSD setpoint
- This application does not require a room sensor.

DHW Heating Operation:

- The tank sensor (FB) monitors domestic water temperature.
- 120v output from terminals 24 & 25 (PS) powers the DHW pump.
- During a call for DHW production the domestic pump (PS) is turned on and the space-heating circuit (PH) is turned off.
- After the DHW recharging and intelligent purge cycle is completed, the PS pump will be shut down and PH circuit will be turned on.

4 Application Drawings



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APPLICATION ECO-003 / MECHANICAL

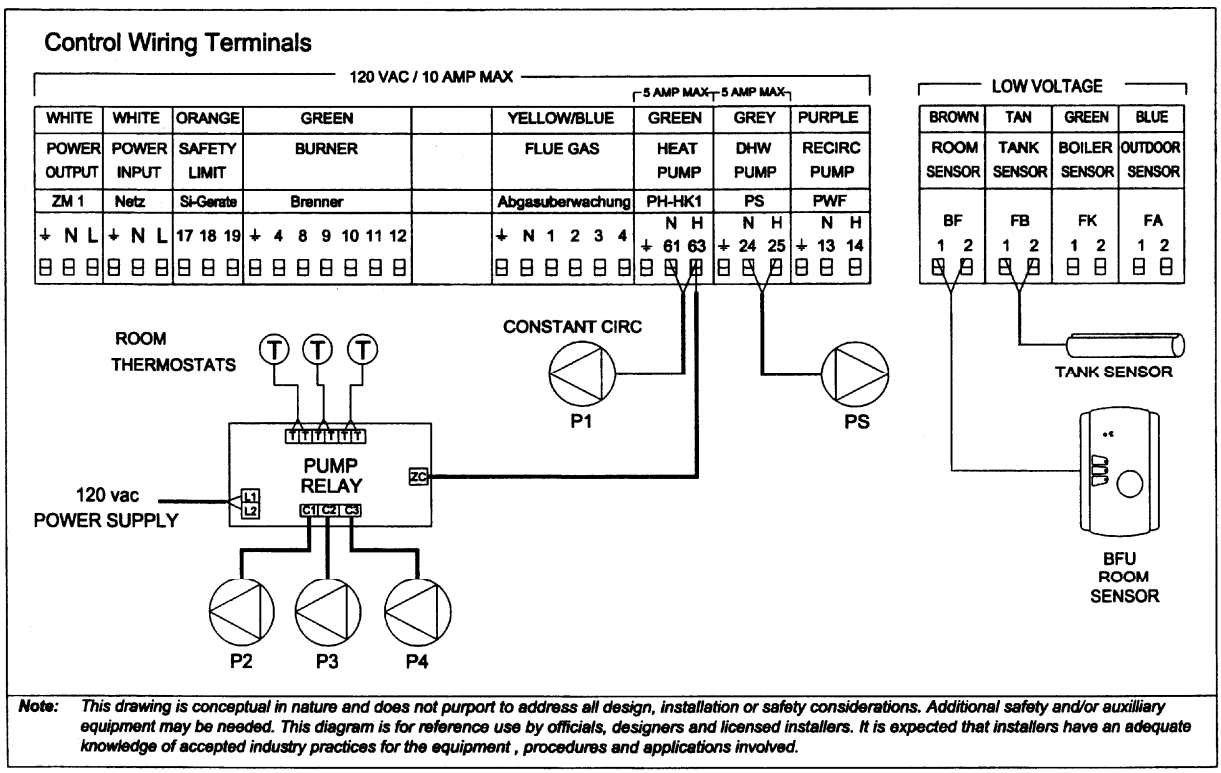
DESCRIPTION:
Multi-Zone Space Heating (with constant circulation zone) / Indirect DHW Heating

Space Heating Operation:

- Boiler temperature is maintained based on the selected heating curve and inputs from both the outdoor sensor and indoor room sensor.
- During setback periods, the boiler temperature will be reduced based on the night setback setting on the room sensor.
- The constant circulation zone pump (P1) will be wired directly to the PH-HK1 circuit on the Ecomatic control. Additional zone pumps require a multi-zone switching relay to operate on a call for heat from a room thermostat.
- Power to the PH-HK1 circuit shall be interrupted under the following conditions:
  1) DHW priority
  2) Condensate protection
  3) Outdoor temperature exceeds WWSD setpoint
  4) Initial part of setback period
- This application requires a room sensor for constant circulation.

DHW Heating Operation:

- The boiler temperature rises on a call for DHW for fast recovery.
- The control powers the domestic pump (PS) and the heating circuit (PH-HK1) is shut down.
- After the DHW recharging and intelligent purge cycle is completed, the PS pump will be shut down and PH-HK1 circuit will be turned on.



Note: *This drawing is conceptual in nature and does not purport to address all design, installation or safety considerations. Additional safety and/or auxilliary equipment may be needed. This diagram is for reference use by officials, designers and licensed installers. It is expected that installers have an adequate knowledge of accepted industry practices for the equipment , procedures and applications involved.*

APPLICATION ECO-003 / ELECTRICAL

DESCRIPTION:
Multi-Zone Space Heating (constant circulation) / Indirect DHW Heating

Space Heating Operation:

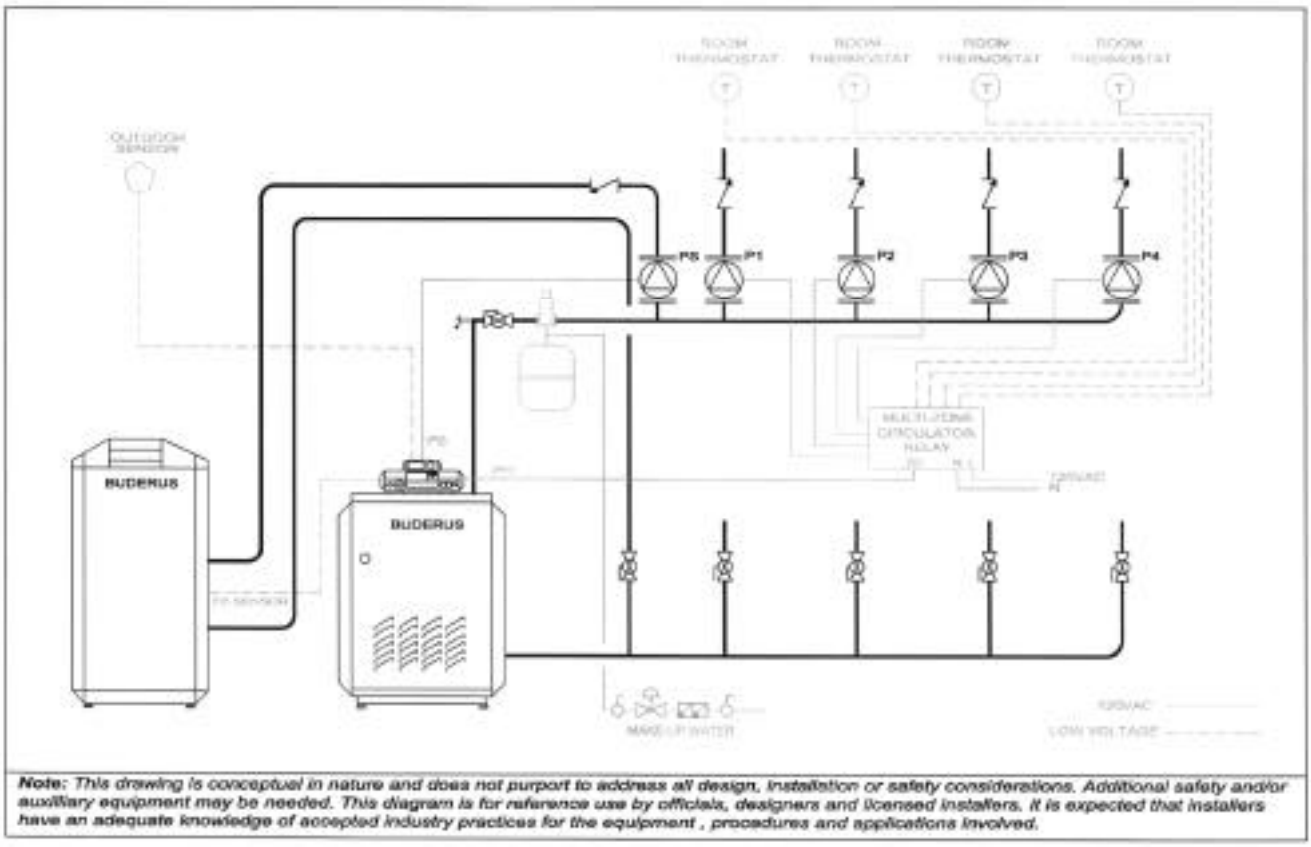
- Boiler temperature is maintained based on the selected heating curve (REF TEMP and OFFSET) and inputs from the outdoor sensor (FA), boiler sensor (FK) and room sensor (BF).
- This application requires a multi-zone pump relay (not supplied by Buderus).
- 120v output from terminal 63 (PH-HK1) will energize the relay. However, the PH-HK1 circuit is limited to a 5 amp maximum load. Therefore, multi-pump applications require an additional source of 120v power to the pump relay. Generally the #63 terminal is wired to the ZC terminal on the relay panel, however relay circuitry can vary. Refer to wiring diagrams provided in this manual for specific manufacturer and model of the relay being used. If the model being used is not listed, contact Buderus for assistance.
- The constant circulation pump (P1) shall run continuously (see following exceptions). All other zone pumps are energized on a call for heat from a room thermostat.
- Power to the pump relay and constant circulation pump shall be interrupted under the following conditions:
  1) DHW priority
  2) Condensate protection
  3) Outdoor temperature exceeds WWSD setpoint
  4) Initial part of setback period
- This application requires a room sensor for constant circulation.
- End switch (X1 - X2) on multi-zone relay panel is not used.

DHW Heating Operation:

- The tank sensor (FB) monitors domestic water temperature.
- 120v output from terminals 24 & 25 (PS) powers the DHW pump.
- During a call for DHW production the domestic pump (PS) is turned on and the space-heating circuit (PH-HK1) is turned off.
- After the DHW recharging and intelligent purge cycle is completed, the PS pump will be shut down and

PH-HK1 circuit will be turned on.

4 Application Drawings



Note: This drawing is conceptual in nature and does not purport to address all design, installation or safety considerations. Additional safety and/or auxiliary equipment may be needed. This diagram is for reference use by officials, designers and licensed installers. It is expected that installers have an adequate knowledge of accepted industry practices for the equipment , procedures and applications involved.

APPLICATION ECO-004 / MECHANICAL

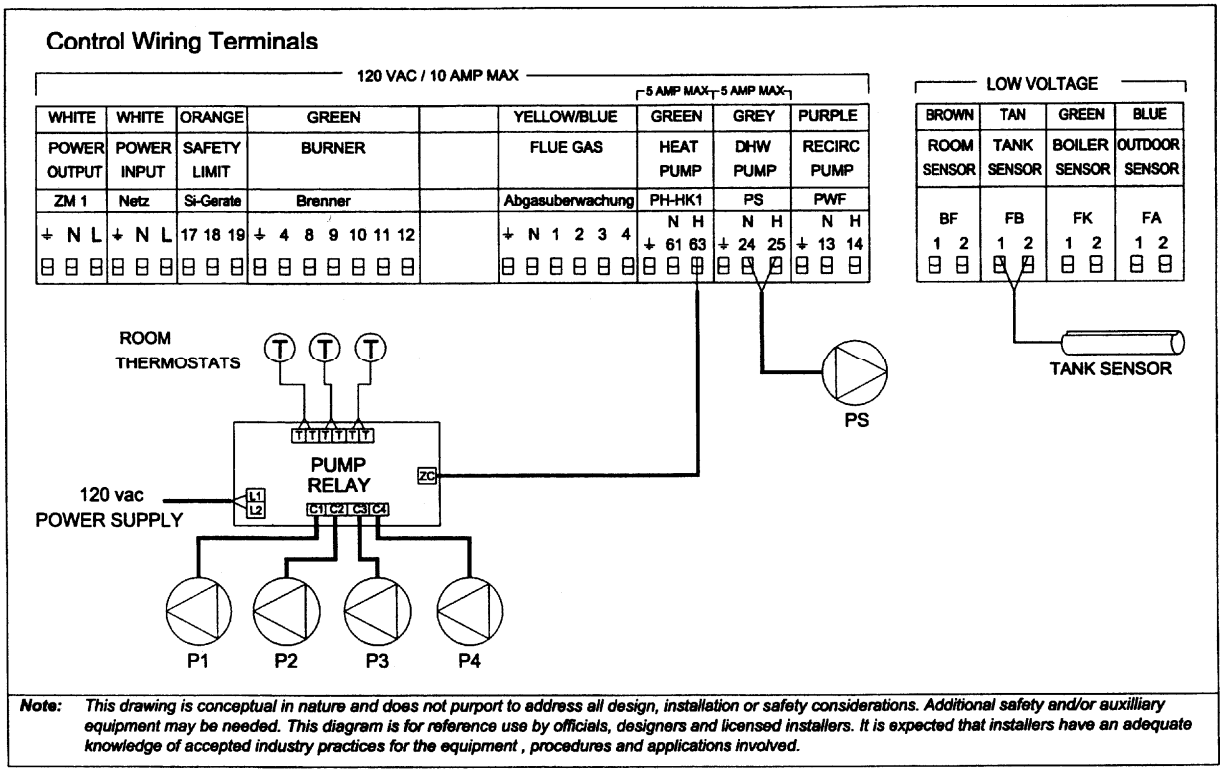
DESCRIPTION:
Multi-Zone Space Heating / Indirect DHW Heating

Space Heating Operation:

- Boiler temperature is maintained based on the selected heating curve and input from the outdoor sensor.
- During setback periods, the boiler temperature will be reduced based on the DAY TEMP and NIGHT TEMP settings on the Ecomatic control.
- Space heating pumps require a multi-zone switching relay to operate on a call for heat from a room thermostat.
- Power to the PH-HK1 circuit shall be interrupted under the following conditions:
  1) DHW priority
  2) Condensate protection
  3) Outdoor temperature exceeds WWSD setpoint
  4) This application does not require a room sensor.

DHW Heating Operation:

- The boiler temperature rises on a call for DHW for fast recovery.
- The control powers the domestic pump (PS) and the heating circuit (PH-HK1) is shut down.
- After the DHW recharging and intelligent purge cycle is completed, the PS pump will be shut down and PH-HK1 circuit will be turned on.



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APPLICATION ECO-004 / ELECTRICAL

DESCRIPTION:
Multi-Zone Space Heating / Indirect DHW Heating

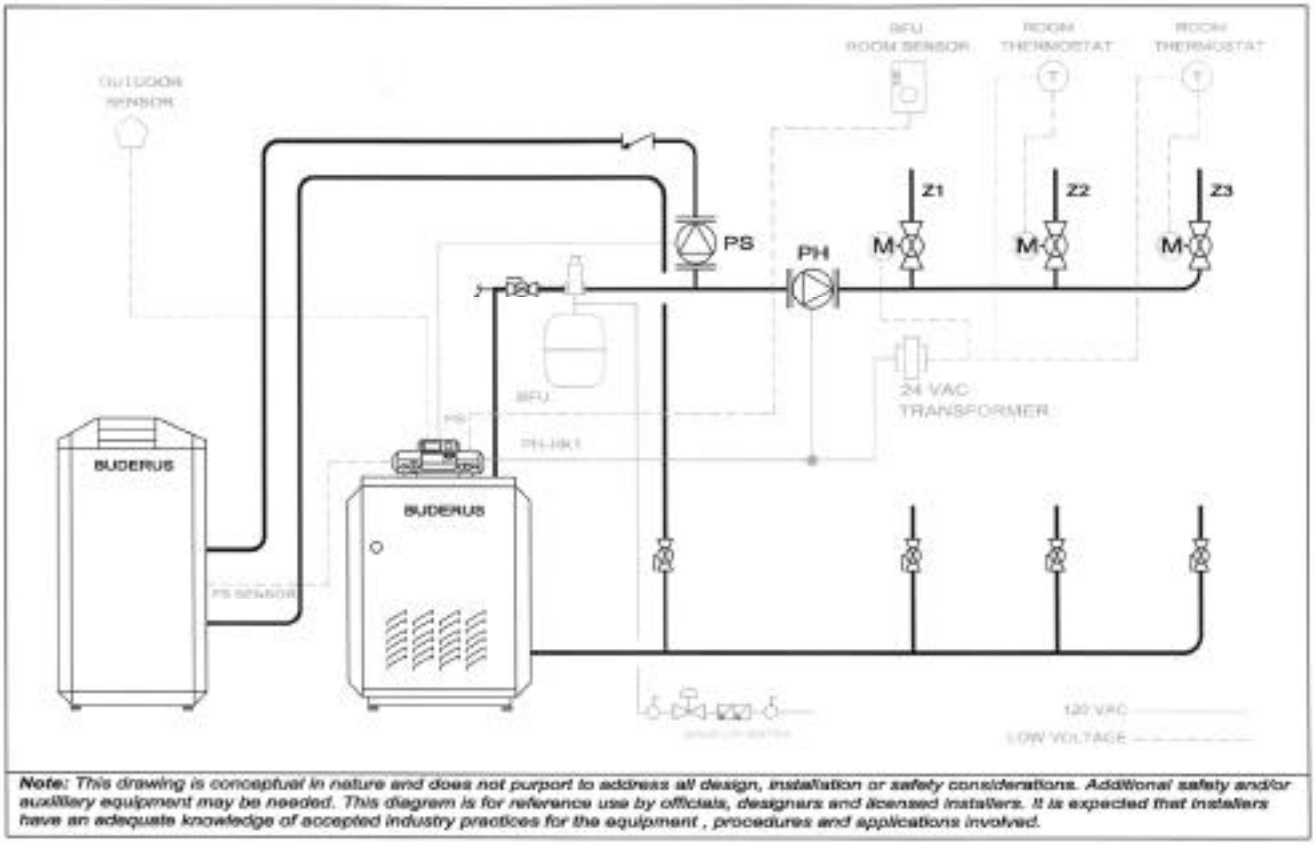
Space Heating Operation:

- Boiler temperature is maintained based on the selected heating curve (REF TEMP and OFFSET) and inputs from the outdoor sensor (FA) and boiler sensor (FK).
- This application requires a multi-zone pump relay (not supplied by Buderus).
- 120v output from terminal 63 (PH-HK1) will energize the relay. However, the PH-HK1 circuit is limited to a 5 amp maximum load. Therefore, multi-pump applications require an additional source of 120v power to the pump relay. Generally the #63 terminal is wired to the ZC terminal on the relay panel, however relay circuitry can vary. Refer to wiring diagrams provided in this manual for specific manufacturer and model of the relay being used. If the model being used is not listed, contact Buderus for assistance.
- Each zone pump is energized on a call for heat from its respective room thermostat. The end switch of the relay panel is not used.
- Power to the pump relay shall be interrupted under the following conditions:
  1) DHW priority
  2) Condensate protection
  3) Outdoor temperature exceeds WWSD setpoint
- This application does not require a room sensor.

DHW Heating Operation:

- The tank sensor (FB) monitors domestic water temperature.
- 120v output from terminals 24 & 25 (PS) powers the DHW pump.
- During a call for DHW production the domestic pump (PS) is turned on and the space-heating circuit (PH-HK1) is turned off.
- After the DHW recharging and intelligent purge cycle is completed, the PS pump will be shut down and PH-HK1 circuit will be turned on.

4 Application Drawings



***Note:** This drawing is conceptual in nature and does not purport to address all design, installation or safety considerations. Additional safety and/or auxiliary equipment may be needed. This diagram is for reference use by officials, designers and licensed installers. It is expected that installers have an adequate knowledge of accepted industry practices for the equipment , procedures and applications involved.*

APPLICATION ECO-005 / MECHANICAL

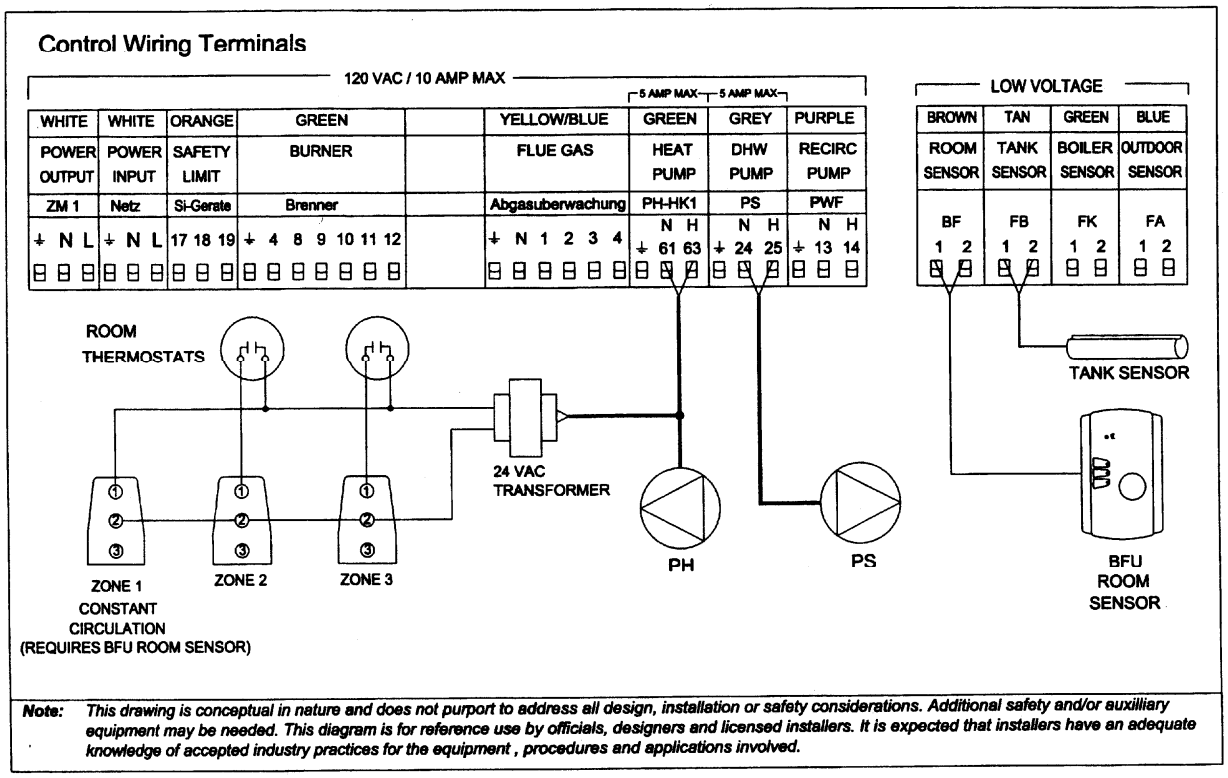
DESCRIPTION:
Multi-Zone Space Heating using Zone Valves (with constant circulation zone) / Indirect DHW Heating

Space Heating Operation:

- Boiler temperature is maintained based on the selected heating curve and inputs from the outdoor sensor and indoor room sensor.
- During setback periods, the boiler temperature will be reduced based on the night setback setting on the BF room sensor.
- Constant circulation zone (Z1): Zone valve will be powered open when the PH-HK1 circuit is on.
- Additional zone valves will open on a call for heat from their respective room thermostats.
- The PH-HK1 circuit and space heating pump (PH) shall have continuous power with following exceptions:
  1) DHW priority
  2) Condensate protection
  3) Outdoor temperature exceeds WWSD setpoint
  4) Initial part of setback period
- This application requires a BF room sensor.

DHW Heating Operation:

- The boiler temperature rises on a call for DHW for fast recovery.
- The control powers the domestic pump (PS) and the heating circuit (PH-HK1) is shut down.
- After the DHW recharging and intelligent purge cycle is completed, the PS pump will be shut down and PH-HK1 circuit will be turned on.



Note: This drawing is conceptual in nature and does not purport to address all design, installation or safety considerations. Additional safety and/or auxilliary equipment may be needed. This diagram is for reference use by officials, designers and licensed installers. It is expected that installers have an adequate knowledge of accepted industry practices for the equipment, procedures and applications involved.

APPLICATION ECO-005 / ELECTRICAL

DESCRIPTION:
Multi-Zone Space Heating using Zone Valves (with constant circulation zone) / Indirect DHW Heating

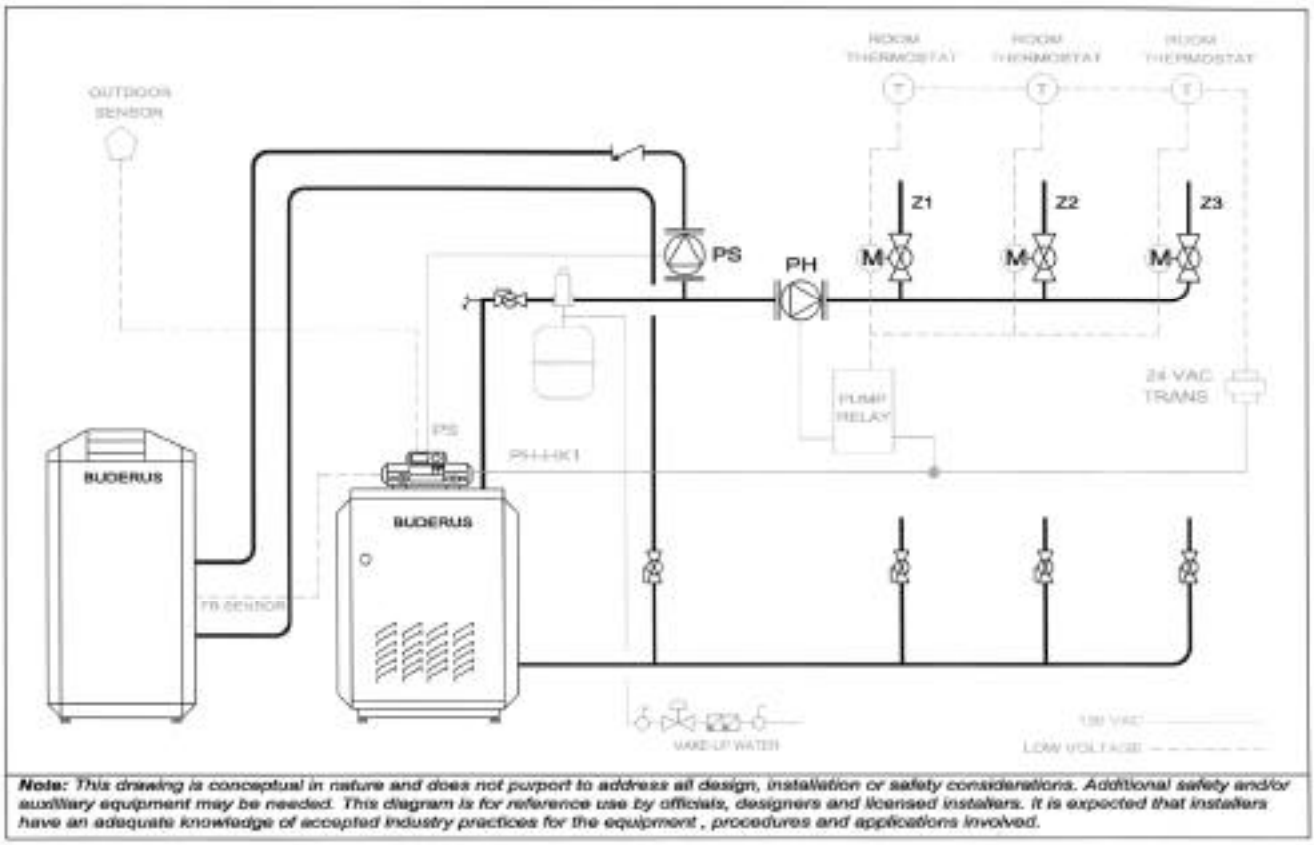
Space Heating Operation:

- Boiler temperature is maintained based on the selected heating curve (REF TEMP and OFFSET) and inputs from the outdoor sensor (FA), boiler sensor (FK) and room sensor (BF).
- This application requires a 24 vac transformer to power zone valves (not supplied by Buderus). Transformer must be sized per manufacturers instructions.
- 120v output from terminal 61 & 63 (PH-HK1) will provide power to both the space heating pump (PH) and the 24 vac transformer.
- The constant circulation zone valve (Z1) will be powered directly from the transformer.
- Additional zone valves open on a call for heat from their respective thermostats. Zone valve end switches are not used.
- The PH-HK1 circuit and space heating pump (PH) shall have continuous power with the following exceptions:
  1) DHW priority
  2) Condensate protection
  3) Outdoor temperature exceeds WWSD setpoint
  4) Initial part of setback period
- This application requires a room sensor for constant circulation.

DHW Heating Operation:

- The tank sensor (FB) monitors domestic water temperature.
- 120v output from terminals 24 & 25 (PS) powers the DHW pump.
- During a call for DHW production the domestic pump (PS) is turned on and the space-heating circuit (PH-HK1) is turned off.
- After the DHW recharging and intelligent purge cycle is completed, the PS pump will be shut down and PH-HK1 circuit will be turned on.

4 Application Drawings



APPLICATION ECO-006 / MECHANICAL

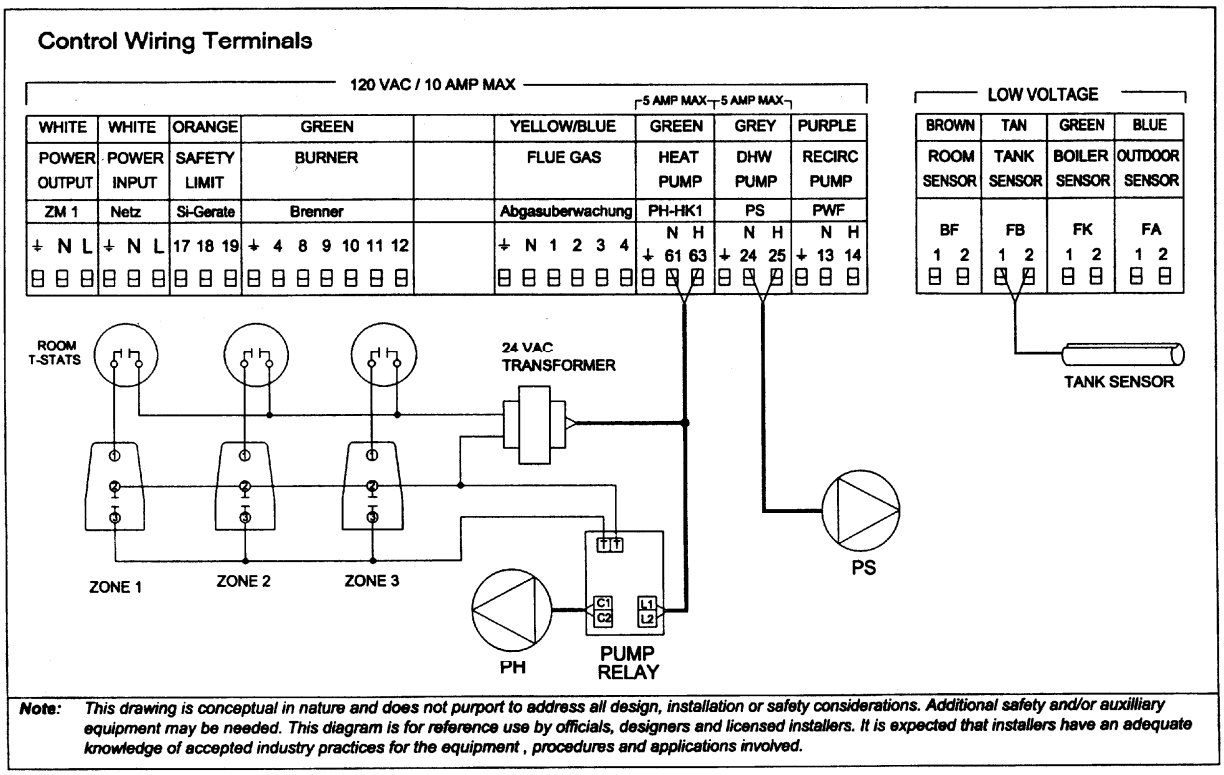
DESCRIPTION:
Multi-Zone Space Heating using Zone Valves / Indirect DHW Heating

Space Heating Operation:

- Boiler temperature is maintained based on the selected heating curve and input from the outdoor sensor.
- During setback periods, the boiler temperature will be reduced based on the DAY TEMP and NIGHT TEMP settings on the Ecomatic control.
- All zones require a call for heat from their respective room thermostats to open zone valve and operate space-heating pump (PH).
- All zone valves will close when the PH-HK1 circuit is turned off.
- The PH-HK1 circuit shall have continuous power with the following exceptions:
  1) DHW priority
  2) Condensate protection
  3) Outdoor temperature exceeds WWSD setpoint
- This application does not require a BF room sensor.

DHW Heating Operation:

- The boiler temperature rises on a call for DHW for fast recovery.
- The control powers the domestic pump (PS) and the heating circuit (PH-HK1) is shut down.
- After the DHW recharging and intelligent purge cycle is completed, the PS pump will be shut down and PH-HK1 circuit will be turned on.



Note: *This drawing is conceptual in nature and does not purport to address all design, installation or safety considerations. Additional safety and/or auxilliary equipment may be needed. This diagram is for reference use by officials, designers and licensed installers. It is expected that installers have an adequate knowledge of accepted industry practices for the equipment , procedures and applications involved.*

APPLICATION ECO-006 / ELECTRICAL

DESCRIPTION:

Multi-Zone Space Heating using Zone Valves / Indirect DHW Heating

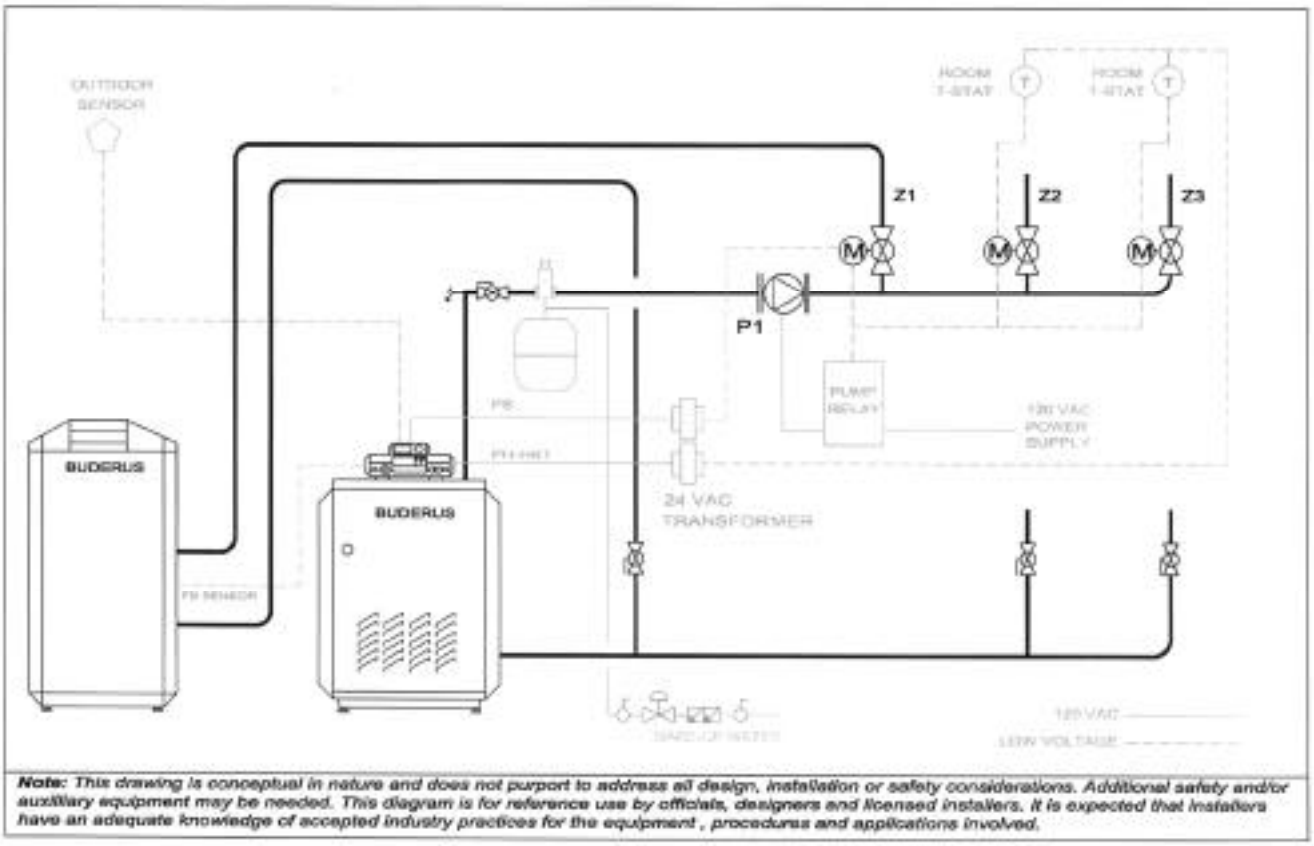
Space Heating Operation:

- Boiler temperature is maintained based on the selected heating curve (REF TEMP and OFFSET) and inputs from the outdoor sensor (FA) and boiler sensor (FK).
- This application requires a 24 vac transformer to power zone valves (not supplied by Buderus). Transformer must be sized per manufacturers instructions.
- This application requires a pump-switching relay (not supplied by Buderus).
- 120v output from terminal 61 & 63 (PH-HK1) will provide power to both the space heating pump relay and the 24 vac transformer.
- Zone valves will open on a call for heat from their respective room thermostats. Zone valve end switches will pull in pump relay to operate space-heating pump (PH).
- The PH-HK1 circuit shall have continuous power with the following exceptions:
  1) DHW priority
  2) Condensate protection
  3) Outdoor temperature exceeds WWSD setpoint
- This application does not require a room sensor.

DHW Heating Operation:

- The tank sensor (FB) monitors domestic water temperature.
- 120v output from terminals 24 & 25 (PS) powers the DHW pump.
- During a call for DHW production the domestic pump (PS) is turned on and the space-heating circuit (PH-HK1) is turned off.
- After the DHW recharging and intelligent purge cycle is completed, the PS pump will be shut down and PH-HK1 circuit will be turned on.

4 Application Drawings



APPLICATION ECO-007 / MECHANICAL

DESCRIPTION:
Multi-Zone Space Heating using Zone Valves (single system pump) / Indirect DHW Heating

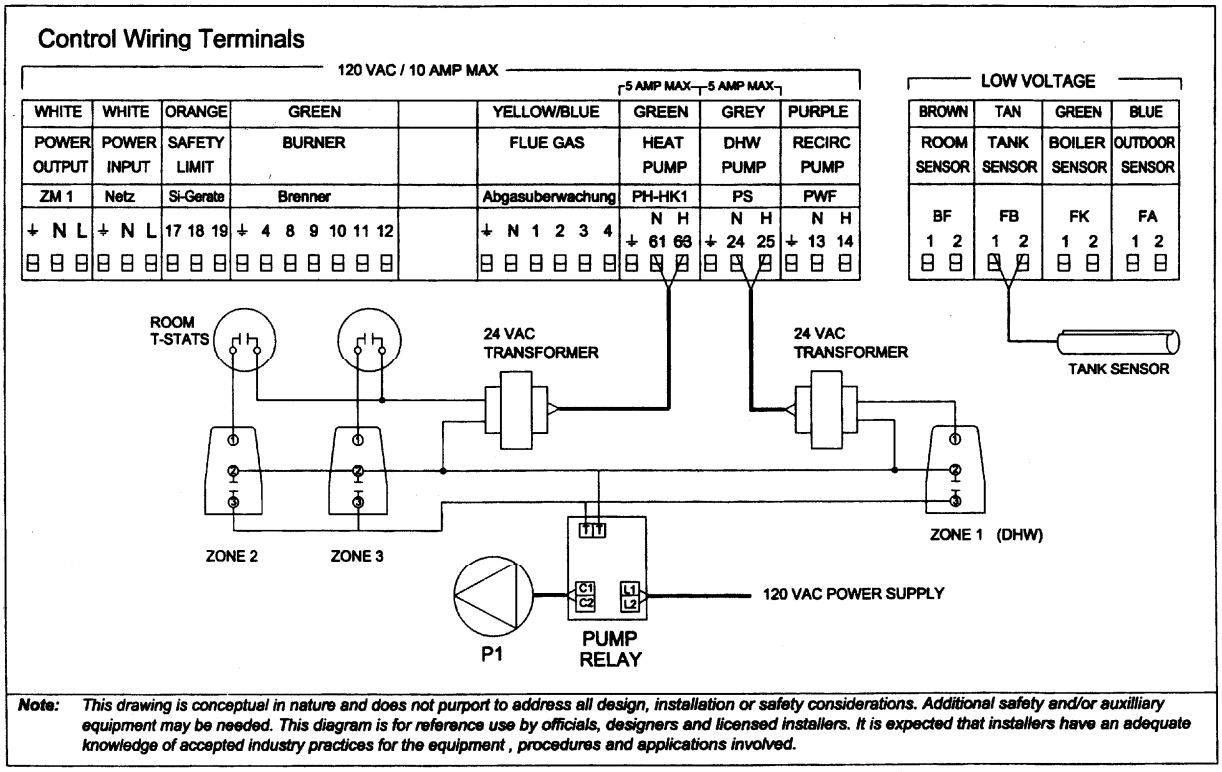
Space Heating Operation:

- Boiler temperature is maintained based on the selected heating curve and input from the outdoor sensor.
- During setback periods, the boiler temperature will be reduced based on the DAY TEMP and NIGHT TEMP settings on the Ecomatic control.
- All zones require a call for heat from their respective room thermostats to open zone valve and operate system pump (PH).
- All space heating zone valves will close when the PH-HK1 circuit is turned off.
- The PH-HK1 circuit shall have continuous power with following exceptions:
  1) DHW priority
  2) Condensate protection
  3) Outdoor temperature exceeds WWSD setpoint
- This application does not require a BF room sensor.

DHW Heating Operation:

- The boiler temperature rises on a call for DHW for fast recovery.
- The control powers the domestic circuit (PS) and the heating circuit (PH-HK1) is shut down.
- After the DHW recharging and intelligent purge cycle is completed, the PS circuit will be shut down and PH-HK1 circuit will be turned on.

- Although this is a common zone controlling method, Buderus Hydronic Systems does not recommend this application with an Ecomatic control.



Note: This drawing is conceptual in nature and does not purport to address all design, installation or safety considerations. Additional safety and/or auxilliary equipment may be needed. This diagram is for reference use by officials, designers and licensed installers. It is expected that installers have an adequate knowledge of accepted industry practices for the equipment, procedures and applications involved.

APPLICATION ECO-007 / ELECTRICAL

DESCRIPTION:
Multi-Zone Space Heating using Zone Valves (single system pump) / Indirect DHW Heating

Space Heating Operation:

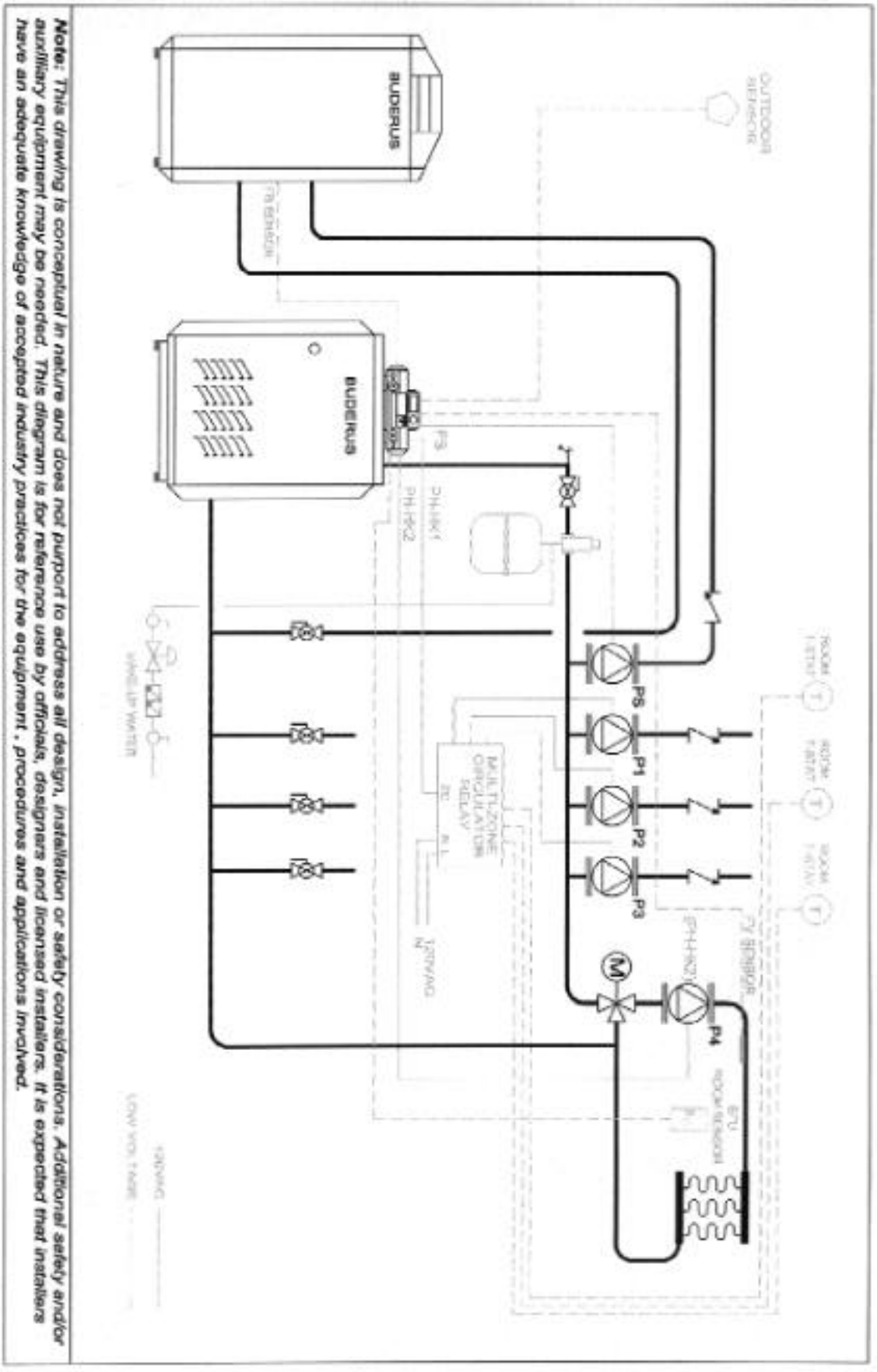
- Boiler temperature is maintained based on the selected heating curve (REF TEMP and OFFSET) and inputs from the outdoor sensor (FA) and boiler sensor (FK).
- This application requires two 24 vac transformers to power zone valves (not supplied by Buderus). Transformers must be sized per manufacturers instructions.
- This application requires a pump-switching relay (not supplied by Buderus).
- 120v output from terminal 61 & 63 (PH-HK1) will provide power to both the space heating pump relay and a 24 vac transformer for space heating zone valves.
- 120v power source must be provided for pump relay (do no wire pump relay to PH-HK1 circuit).
- Zone valves will open on a call for heat from their respective room thermostats. Zone valve end switches will pull in the pump relay to operate system pump (P1).
- The PH-HK1 circuit shall have continuous power with the following exceptions:
  1) DHW priority
  2) Condensate protection
  3) Outdoor temperature exceeds WWSD setpoint
- This application does not require a room sensor.

DHW Heating Operation:

- The tank sensor (FB) monitors domestic water temperature.
- 120v output from terminals 24 & 25 (PS) will provide power to transformer for DHW zone valve. The transformer will directly power open DHW zone valve (Z1) and the end switch will pull in the system pump (P1).
- During a call for DHW production the domestic circuit (PS) is turned on and the space-heating circuit (PH-HK1) is turned off.
- After the DHW recharging and intelligent purge cycle is completed, the PS circuit will be shut down and PH-HK1 circuit will be turned on.

4 Application Drawings

APPLICATION ECO-008 / MECHANICAL



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APPLICATION ECO-008 / MECHANICAL

DESCRIPTION:
Multi-Zone High Temp Space Heating / Radiant Floor Heating with FM241 module and Motorized Mixing Valve / Indirect DHW Heating

Space Heating Operation:
HK1 circuit (high temperature)

- Boiler temperature is maintained based on the selected heating curve and input from the outdoor sensor.
- During setback periods, the boiler temperature will be reduced based on the DAY TEMP and NIGHT TEMP settings on the Ecomatic control.
- Space heating pumps require a multi-zone switching relay to operate on a call for heat from a room thermostat.
- The PH-HK1 circuit shall be wired to the multi-zone pump relay to interrupt power to the space heating pumps under the following conditions:
  1) DHW priority
  2) Condensate protection
  3) Outdoor temperature exceeds WWSD setpoint
- This application does not require a room sensor for high temperature space heating.

HK2 circuit (mixed temperature)

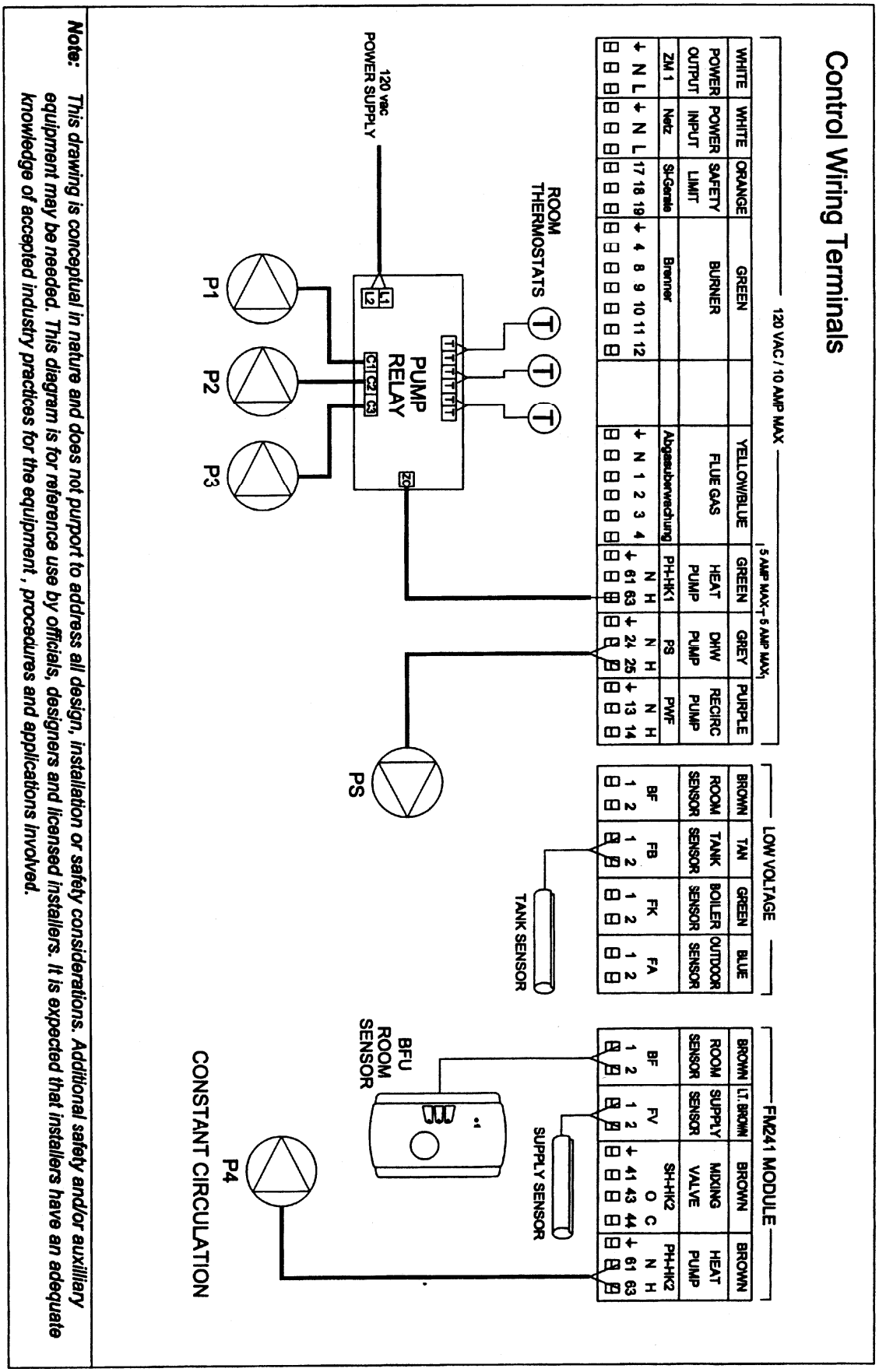
- Mixed water temperature is maintained based on the selected heating curve and input from the outdoor sensor (FA), supply sensor (FV) and room sensor.
- During setback periods, the boiler temperature will be reduced based on the night setback setting on the room sensor.
- Power to the PH-HK2 circuit is turned off under the following conditions:
  1) Initial part of night setback period
  2) Condensate protection
  3) Outdoor temperature exceeds WWSD setpoint
- This application requires a room sensor for radiant floor heating.

DHW Heating Operation:

- The boiler temperature rises on a call for DHW for fast recovery.
- The control powers the domestic pump (PS) and the heating circuit (PH-HK1) is shut down.
- The PH-HK2 pump will continue to operate during the DHW cycle. The mixing valve can be set to either continue normal operation or fully close to prioritize DHW production. (Refer to the Ecomatic Service Manual for setting options)
- After the DHW recharging and intelligent purge cycle is completed, the PS pump will be shut down and PH-HK1 circuit will be turned on.

4 Application Drawings

APPLICATION ECO-008 / ELECTRICAL



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APPLICATION ECO-008 / ELECTRICAL

DESCRIPTION:
Multi-Zone High Temp Zone Space Heating / Radiant Floor Heating with FM241 and Motorized Mixing Valve / Indirect DHW Heating

Space Heating Operation:
HK1 circuit (high temperature)

- Boiler temperature is maintained based on the selected heating curve (REF TEMP 1 and OFFSET 1) and inputs from the outdoor sensor (FA) and boiler sensor (FK).
- This application requires a multi-zone pump relay (not supplied by Buderus).
- 120v output from terminal 63 (PH-HK1) will energize the relay. However, the PH-HK1 circuit is limited to a 5 amp maximum load. Therefore, multi-pump applications require an additional source of 120v power to the pump relay. Generally the #63 terminal is wired to the ZC terminal on the relay panel, however relay circuitry can vary. Refer to wiring diagrams provided in this manual for specific manufacturer and model of the relay being used. If the model being used is not listed, contact Buderus for assistance.
- Each zone pump is energized on a call for heat from its respective room thermostat. The end switch of the relay panel is not used.
- Power to the pump relay shall be interrupted under the following conditions:
  1) DHW priority
  2) Condensate protection
  3) Outdoor temperature exceeds WWSD setpoint
- This application does not require a room sensor for high temperature space heating.

HK2 circuit (mixed temperature)

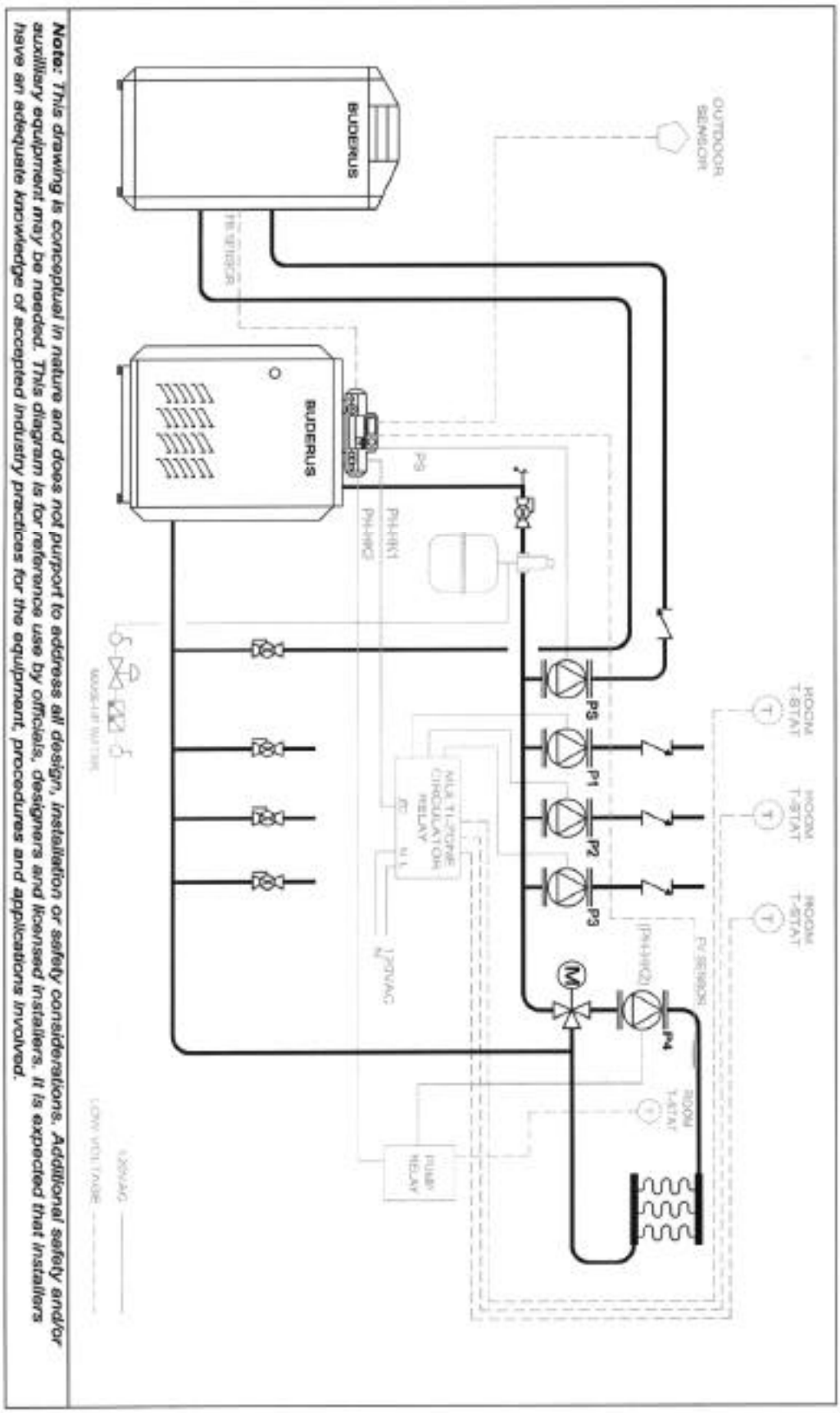
- Mixed water temperature is maintained based on the selected heating curve (REF TEMP 2 and OFFSET 2) and inputs from the outdoor sensor (FA), supply sensor (FV) and room sensor (BF).
- 120v output from terminal 61 & 63 (PH-HK2) provide power to pump P4. The PH-HK2 circuit is limited to a 2 amp maximum draw. It is important that the amp rating of the pump be verified to ensure that the circuit is not overloaded. Use an isolation relay if max amp rating is exceeded.
- This application requires a BF room sensor for radiant floor heating.

DHW Heating Operation:

- The tank sensor (FB) monitors domestic water temperature.
- 120v output from terminals 24 & 25 (PS) powers the DHW pump.
- During a call for DHW production the domestic pump (PS) is turned on and the space-heating circuit (PH-HK1) is turned off.
- After the DHW recharging and intelligent purge cycle is completed, the PS pump will be shut down and PH-HK1 circuit will be turned on.
- During the DHW cycle the PH-HK2 circuit remains on. The mixing valve can be set to either continue normal operation or fully close to prioritize DHW production. (Refer to the Ecomatic Service Manual for setting options)

4 Application Drawings

APPLICATION ECO-009 / MECHANICAL



Note: *This drawing is conceptual in nature and does not purport to address all design, installation or safety considerations. Additional safety and/or auxiliary equipment may be needed. This diagram is for reference use by officials, designers and licensed installers. It is expected that installers have an adequate knowledge of accepted industry practices for the equipment, procedures and applications involved.*

APPLICATION ECO-009 / MECHANICAL

DESCRIPTION:
Multi-Zone High Temp Space Heating / Radiant Floor Heating with FM241 module and Motorized Mixing Valve (no constant circulation zones) / Indirect DHW Heating

Space Heating Operation:

HK1 circuit (high temperature)

- Boiler temperature is maintained based on the selected heating curve and input from the outdoor sensor.
- During setback periods, the boiler temperature will be reduced based on the DAY TEMP 1 and NIGHT TEMP 2 settings on the Ecomatic.
- Space heating pumps require a multi-zone switching relay to operate on a call for heat from a room thermostat.
- The PH-HK1 circuit shall be wired to the multi-zone pump relay to interrupt power to the space heating pumps under the following conditions:
  1) DHW priority
  2) Condensate protection
  3) Outdoor temperature exceeds WWSD setpoint
- This application does not require a room sensor for high temperature space heating.

HK2 circuit (mixed temperature)

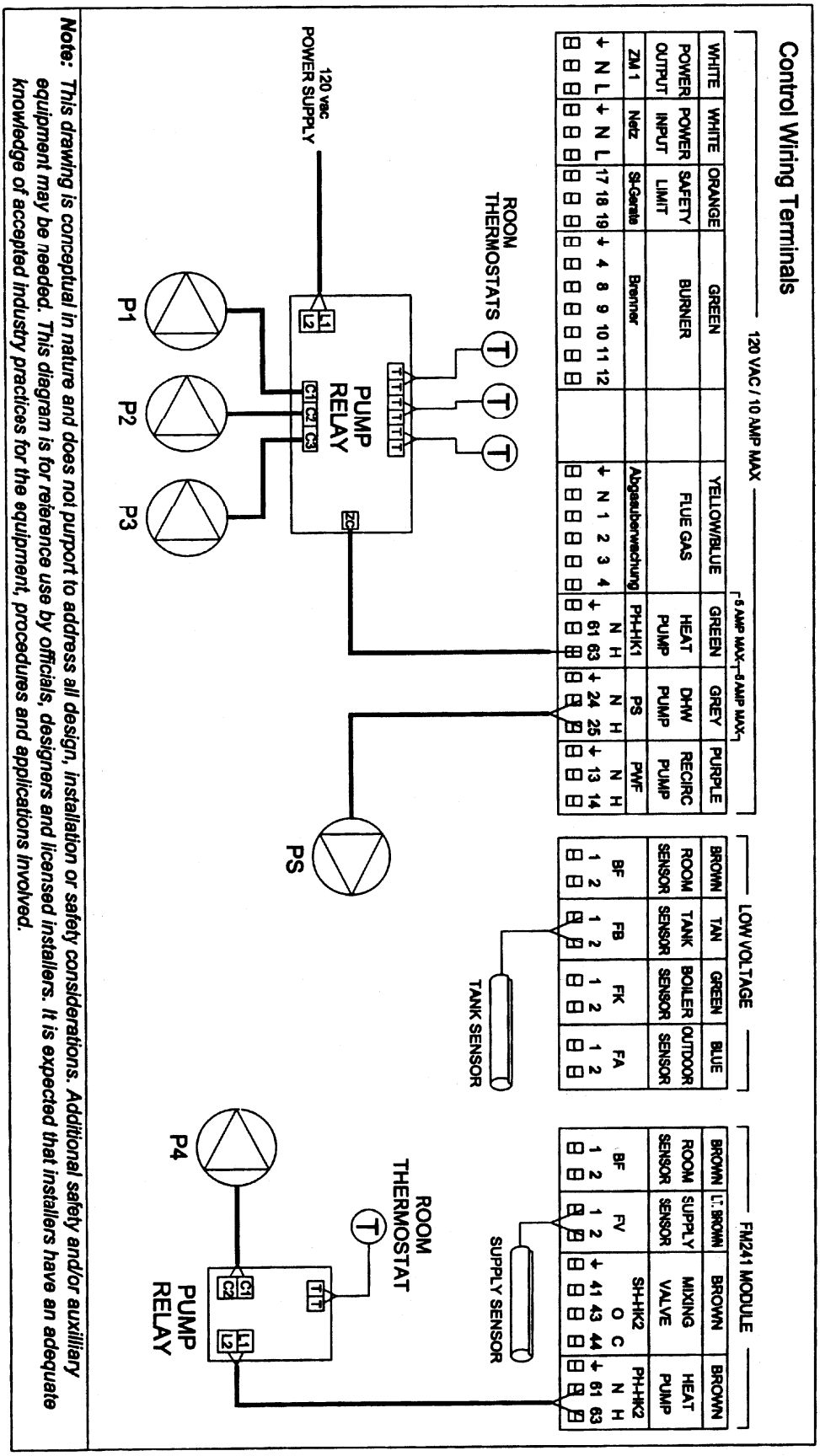
- Mixed water temperature is maintained based on the selected heating curve and input from the outdoor sensor (FA) and supply sensor (FV).
- During setback periods, the boiler temperature will be reduced based on the DAY TEMP 2 and NIGHT TEMP 2 settings on the Ecomatic.
- The PH-HK2 circuit requires a pump switching relay to operate pump P4 on call for heat from a room thermostat.
- Power to the PH-HK2 circuit is turned off under the following conditions:
  1) Initial part of night setback period
  2) Condensate protection
  3) Outdoor temperature exceeds WWSD setpoint
- This application does not require a room sensor for radiant floor heating.

DHW Heating Operation:

- The boiler temperature rises on a call for DHW for fast recovery.
- The control powers the domestic pump (PS) and the heating circuit (PH-HK1) is shut down.
- The PH-HK2 pump will continue to operate during the DHW cycle. The mixing valve can be set to either continue normal operation or fully close to prioritize DHW production. (Refer to the Ecomatic Service Manual for setting options)
- After the DHW recharging and intelligent purge cycle is completed, the PS pump will be shut down and PH-HK1 circuit will be turned on.

4 Application Drawings

APPLICATION ECO-009 / ELECTRICAL



Note: *This drawing is conceptual in nature and does not purport to address all design, installation or safety considerations. Additional safety and/or auxilliary equipment may be needed. This diagram is for reference use by officials, designers and licensed installers. It is expected that installers have an adequate knowledge of accepted industry practices for the equipment, procedures and applications involved.*

APPLICATION ECO-009 / ELECTRICAL

DESCRIPTION:
Multi-Zone High Temp Zone Space Heating / Radiant Floor Heating with FM241 and Motorized Mixing Valve (no constant circulation zones) / Indirect DHW Heating

Space Heating Operation:
HK1 circuit (high temperature)

- Boiler temperature is maintained based on the selected heating curve (REF TEMP 1 and OFFSET 1) and inputs from the outdoor sensor (FA) and boiler sensor (FK).
- This application requires a multi-zone pump relay (not supplied by Buderus).
- 120v output from terminal 63 (PH-HK1) will energize the relay. However, the PH-HK1 circuit is limited to a 5 amp maximum load. Therefore, multi-pump applications require an additional source of 120v power to the pump relay. Generally the #63 terminal is wired to the ZC terminal on the relay panel, however relay circuitry can vary. Refer to wiring diagrams provided in this manual for specific manufacturer and model of the relay being used. If the model being used is not listed, contact Buderus for assistance.
- Each zone pump is energized on a call for heat from its respective room thermostat. The end switch of the relay panel is not used.
- Power to the pump relay shall be interrupted under the following conditions:
  1) DHW priority
  2) Condensate protection
  3) Outdoor temperature exceeds WWSD setpoint
- This application does not require a room sensor for high temperature space heating.

HK2 circuit (mixed temperature)

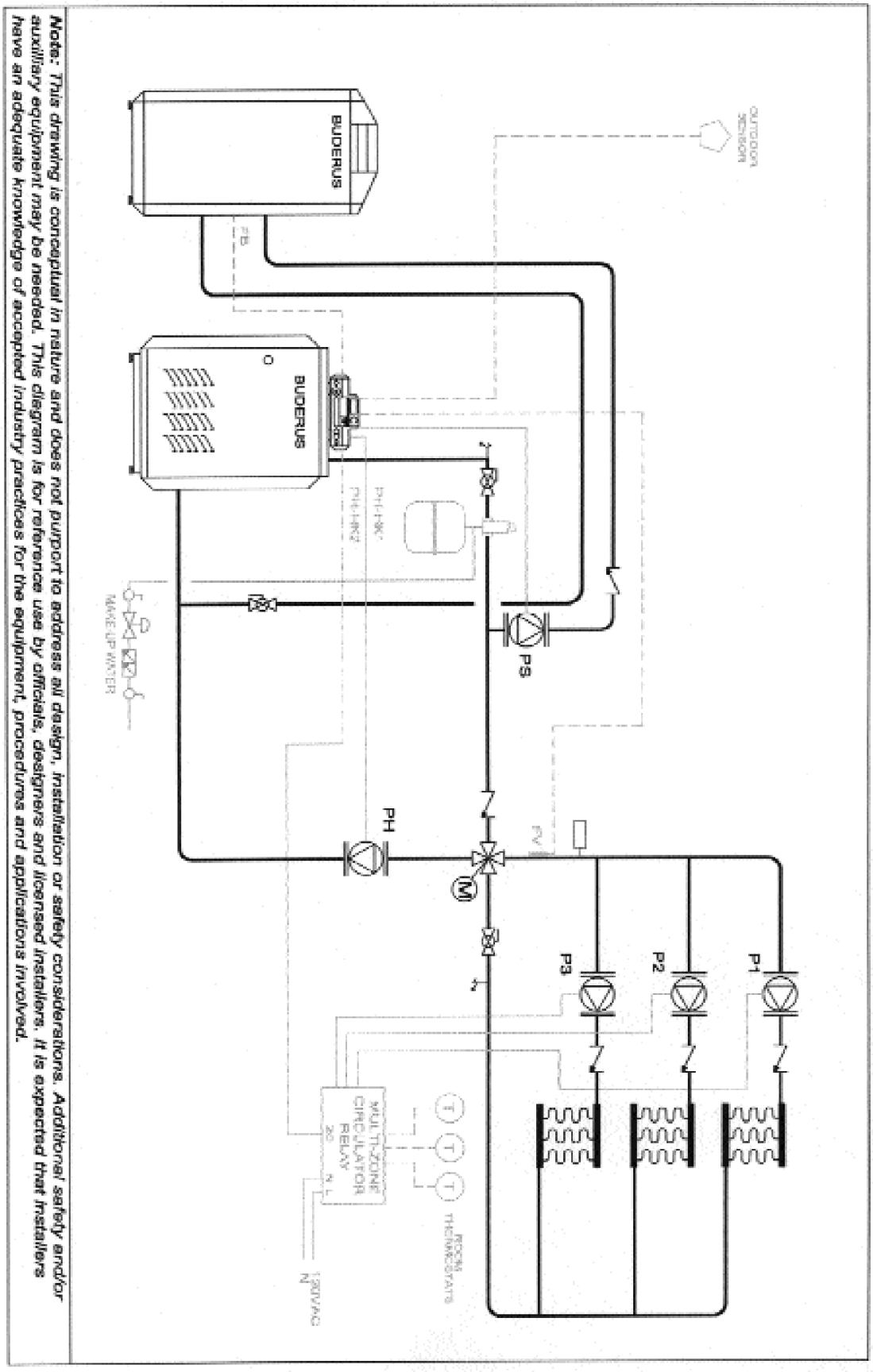
- Mixed water temperature is maintained based on the selected heating curve (REF TEMP 2 and OFFSET 2) and inputs from the outdoor sensor (FA) and supply sensor (FV).
- 120v output from terminals 61 & 63 (PH-HK2) provide power to pump relay. The PH-HK2 circuit is limited to a 2 amp maximum draw. It is important to verify the total amp rating for this circuit. Use an isolation relay if max amp rating is exceeded.
- This application does not require a room sensor for radiant floor heating.

DHW Heating Operation:

- The tank sensor (FB) monitors domestic water temperature.
- 120v output from terminals 24 & 25 (PS) powers the DHW pump.
- During a call for DHW production the domestic pump (PS) is turned on and the space-heating circuit (PH-HK1) is turned off.
- After the DHW recharging and intelligent purge cycle is completed, the PS pump will be shut down and PH-HK1 circuit will be turned on.
- During the DHW cycle the PH-HK2 circuit remains on. The mixing valve can be set to either continue normal operation or fully close to prioritize DHW production. (Refer to the Ecomatic Service Manual for setting options)

4 Application Drawings

APPLICATION ECO-010 / MECHANICAL



Note: This drawing is conceptual in nature and does not purport to address all design, installation or safety considerations. Additional safety and/or auxilliary equipment may be needed. This diagram is for reference use by officials, designers and licensed installers. It is expected that installers have an adequate knowledge of accepted industry practices for the equipment, procedures and applications involved.

APPLICATION ECO-010 / MECHANICAL

DESCRIPTION:
Multi-Zone Radiant Floor Heating with FM241 module and Motorized Mixing Valve / Indirect DHW Heating

Space Heating Operation:
HK1 circuit (high temperature)

- System pump PH shall run continuously with the following exception:
  1) Condensate protection
  2) Outdoor temperature exceeds WWSD setpoint
  3) DHW priority
- The system pump may also shut down during the initial part of night setback period if a BF room sensor is being used for high temperature space heating.

To simplify this application, it is being shown without high temperature space heating. Refer to previous application diagrams for high temp heating.

HK2 circuit (mixed temperature)

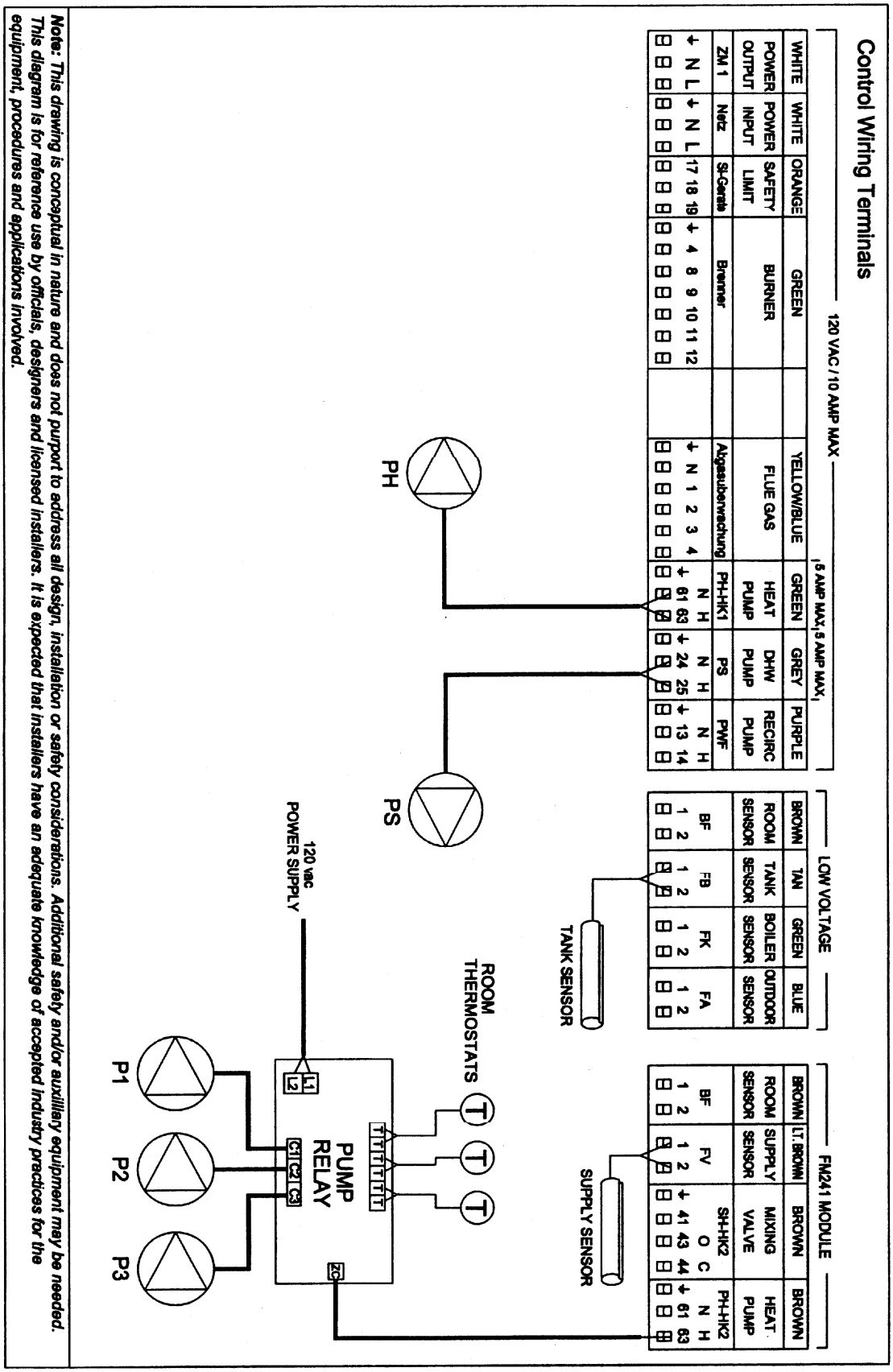
- Water temperature is modulated based on the selected heating curve and input from the outdoor (FA) and supply (FV) sensors.
- During setback periods, the water temperature can be reduced based on the DAY TEMP 2 and NIGHT TEMP 2 settings.
- Space heating pumps (P1,P2,P3) require a multi-zone pump relay to operate on a call for heat from room thermostats.
- The PH-HK2 circuit shall be wired to the multi-zone pump relay to interrupt power to the space heating pumps under the following conditions:
  1) Condensate protection
  2) Outdoor temperature exceeds WWSD setpoint
- This application does not require a room sensor for radiant floor heating.

DHW Heating Operation:

- The boiler temperature rises on a call for DHW for fast recovery.
- The control powers the domestic pump (PS) and the heating circuit (PH-HK1) is shut down.
- The PH-HK2 circuit will remain on during the DHW cycle. The mixing valve can be set to either continue normal operation or fully close to prioritize DHW production. (Refer to the Ecomatic Service Manual for setting options)
- After the DHW recharging and intelligent purge cycle is completed, the PS pump will be shut down and PH-HK1 circuit will be turned on.

4 Application Drawings

APPLICATION ECO-010 / ELECTRICAL



***Note:** This drawing is conceptual in nature and does not purport to address all design, installation or safety considerations. Additional safety and/or auxiliary equipment may be needed. This diagram is for reference use by officials, designers and licensed installers. It is expected that installers have an adequate knowledge of accepted industry practices for the equipment, procedures and applications involved.*

APPLICATION ECO-010 / ELECTRICAL

DESCRIPTION:
Radiant Floor Heating with FM241 and Motorized Mixing Valve / Indirect DHW Heating

Space Heating Operation:
HK1 circuit (high temperature)

- 120v output from terminals 61 & 63 (PH-HK1) provide power to the system pump (PH).

HK2 circuit (mixed temperature)

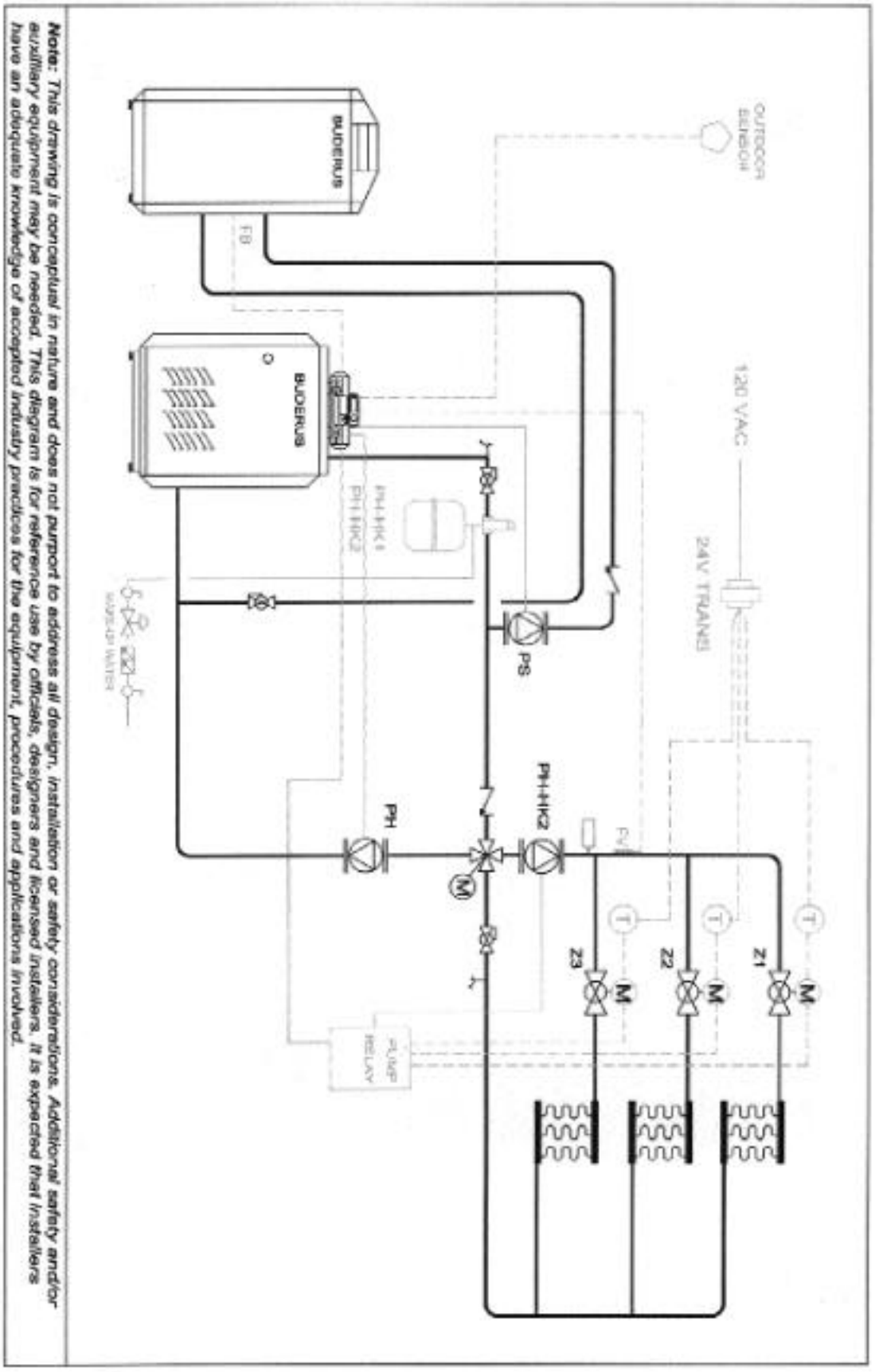
- Mixed water temperature is maintained based on the selected heating curve (REF TEMP 2 and OFFSET 2) and inputs from the outdoor sensor (FA) and supply sensor (FV).
- This application requires a multi-zone pump relay (not supplied by Buderus).
- 120v output from terminal 63 (PH-HK2) will energize the relay. However, the PH-HK2 circuit is limited to a 2 amp maximum load. Therefore, multi-pump applications require an additional source of 120v power to the pump relay. Generally the #63 terminal is wired to the ZC terminal on the relay panel, however relay circuitry can vary. Refer to wiring diagrams provided in this manual for specific manufacturer and model of the relay being used. If the model being used is not listed, contact Buderus for assistance.
- Each zone pump is energized on a call for heat from its respective room thermostat. The end switch of the relay panel is not used.
- Power to the pump relay shall be interrupted under the following conditions:
  1)Condensate protection
  2)Outdoor temperature exceeds WWSD setpoint
- This application does not require a room sensor for radiant floor heating.

DHW Heating Operation:

- The tank sensor (FB) monitors domestic water temperature.
- 120v output from terminals 24 & 25 (PS) powers the DHW pump.
- During a call for DHW production the domestic pump (PS) is turned on and the space-heating circuit (PH-HK1) is turned off.
- After the DHW recharging and intelligent purge cycle is completed, the PS pump will be shut down and PH-HK1 circuit will be turned on.
- During the DHW cycle the PH-HK2 circuit remains on. The mixing valve can be set to either continue normal operation or fully close to prioritize DHW production. (Refer to the Ecomatic Service Manual for setting options)

4 Application Drawings

APPLICATION ECO-011 / MECHANICAL



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APPLICATION ECO-011 / MECHANICAL

DESCRIPTION:
Multi-Zone Radiant Floor Heating (using zone valves) with FM241 module and Motorized Mixing Valve / Indirect DHW Heating

Space Heating Operation:
HK1 circuit (high temperature)

- System pump PH shall run continuously with the following exception:
  1)Condensate protection
  2)Outdoor temperature exceeds WWSD setpoint
  3)DHW priority
- The system pump may also shut down during the initial part of night setback period if a BF room sensor is being used for high temperature space heating.

- To simplify this application, it is being shown without high temperature space heating. Refer to previous application diagrams for high temp heating.

HK2 circuit (mixed temperature)

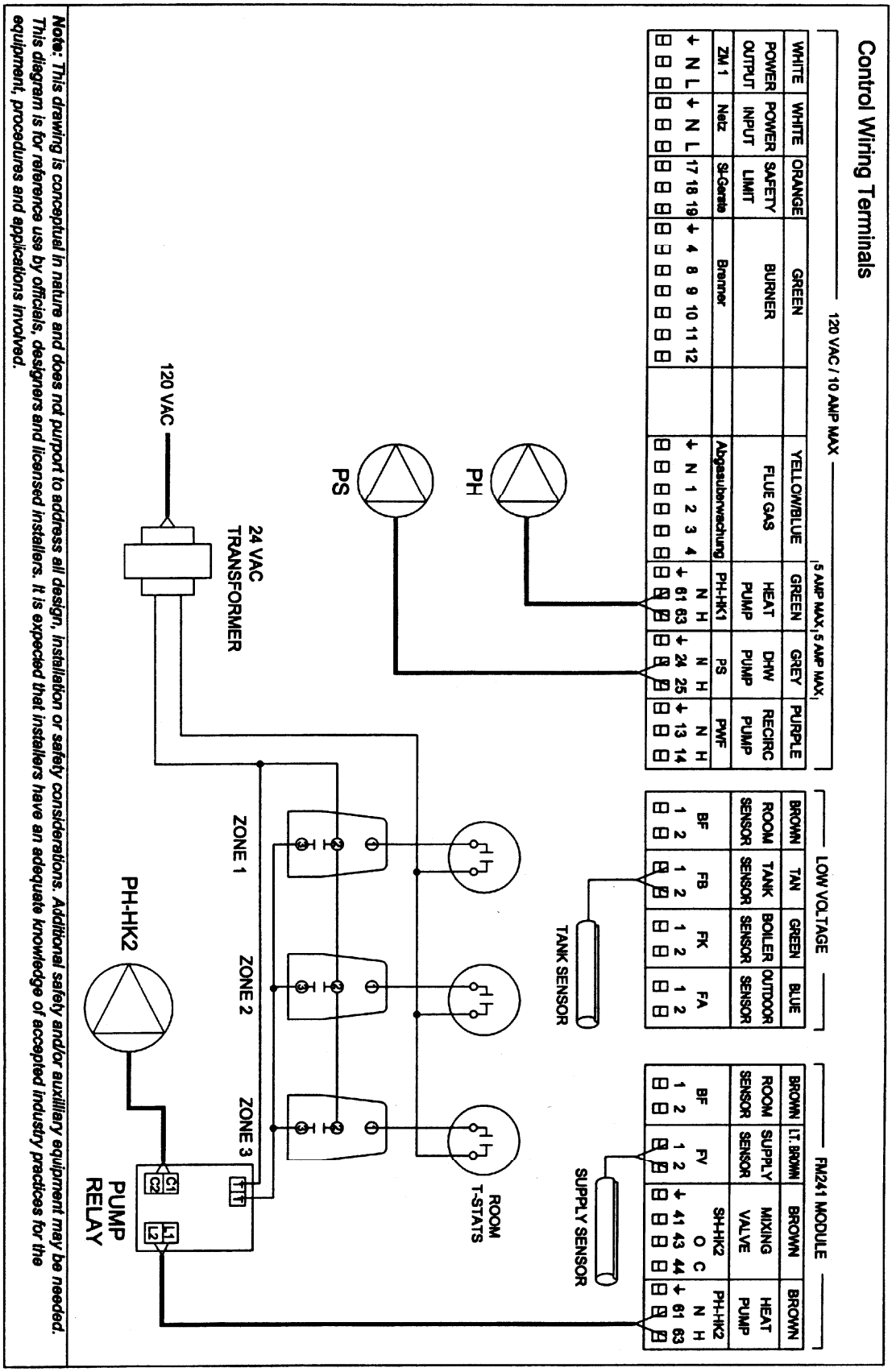
- Water temperature is modulated based on the selected heating curve and input from the outdoor (FA) and supply (FV) sensors.
- During setback periods, the water temperature can be reduced based on the DAY TEMP 2 and NIGHT TEMP 2 settings.
- All zones require a call for heat from a room thermostat to open zone valve and operate space-heating pump (PH-HK2).
- Power to the PH-HK2 circuit shall be interrupted under the following conditions:
  1)Condensate protection
  2)Outdoor temperature exceeds WWSD setpoint
- This application does not require a room sensor for radiant floor heating.

DHW Heating Operation:

- The boiler temperature rises on a call for DHW for fast recovery.
- The control powers the domestic pump (PS) and the heating circuit (PH-HK1) is shut down.
- The PH-HK2 circuit will remain on during the DHW cycle. The mixing valve can be set to either continue normal operation or fully close to prioritize DHW production. (Refer to the Ecomatic Service Manual for setting options)
- After the DHW recharging and intelligent purge cycle is completed, the PS pump will be shut down and PH-HK1 circuit will be turned on.

4 Application Drawings

APPLICATION ECO-011 / ELECTRICAL



***Note:** This drawing is conceptual in nature and does not purport to address all design, installation or safety considerations. Additional safety and/or auxilliary equipment may be needed. This diagram is for reference use by officials, designers and licensed installers. It is expected that installers have an adequate knowledge of accepted industry practices for the equipment, procedures and applications involved.*

APPLICATION ECO-011 / ELECTRICAL

DESCRIPTION:
Radiant Floor Heating (using zone valves) with FM241 and Motorized Mixing Valve / Indirect DHW Heating

Space Heating Operation:
HK1 circuit (high temperature)

- Boiler temperature is maintained based on the selected heating curve (REF TEMP 1 and OFFSET 1) and inputs from the outdoor sensor (FA) and boiler sensor (FK).
- 120v output from terminals 61 & 63 (PH-HK1) provide power to the system pump (PH).

HK2 circuit (mixed temperature)

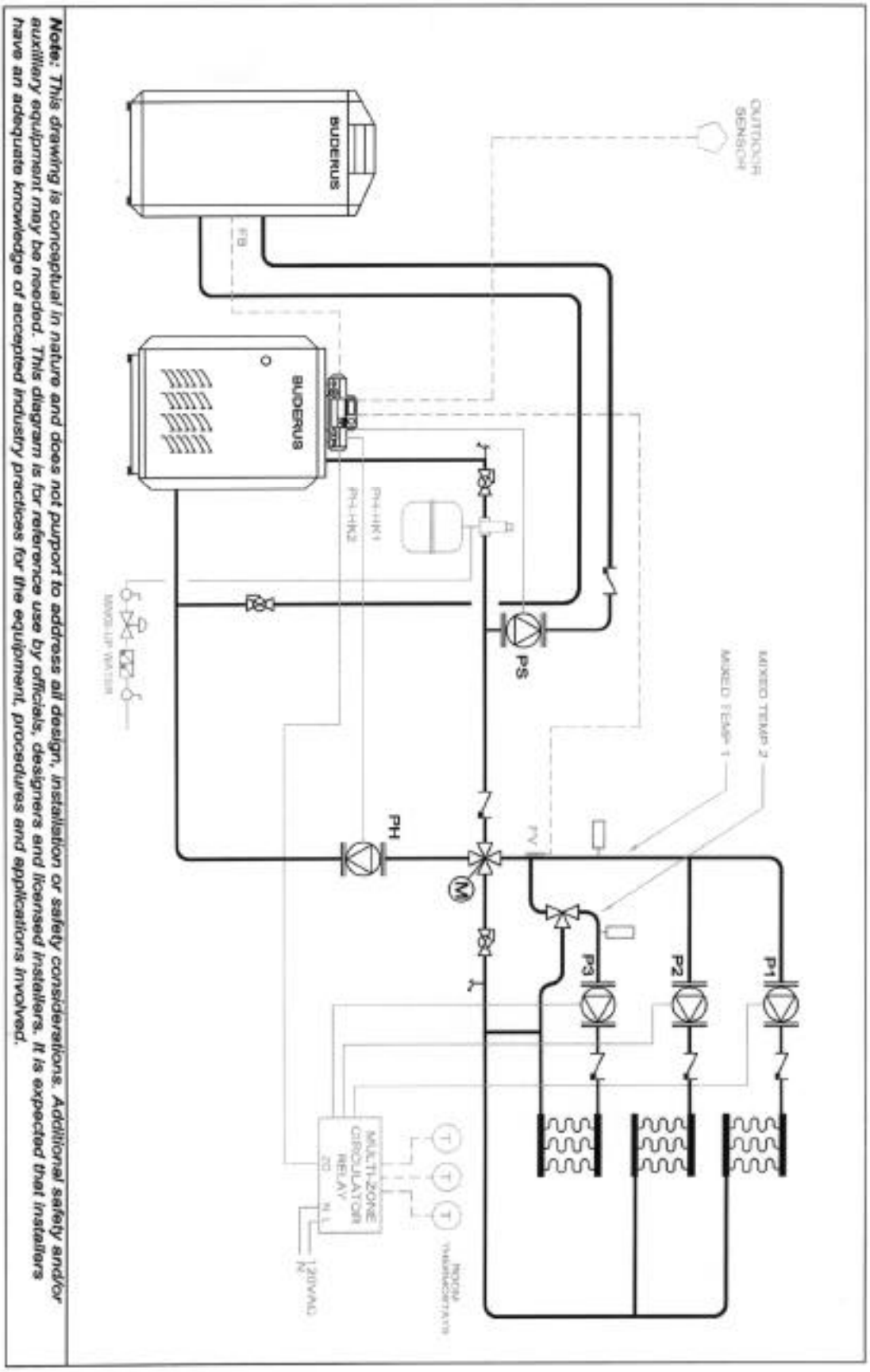
- Mixed water temperature is maintained based on the selected heating curve (REF TEMP 2 and OFFSET 2) and inputs from the outdoor sensor (FA) and supply sensor (FV).
- This application requires a pump-switching relay (not supplied by Buderus).
- 120v output from terminal 63 (PH-HK2) will energize the relay. The PH-HK2 circuit is limited to a 2 amp maximum load. It is important to verify the total amp rating for this circuit. Use an isolation relay if max amp rating is exceeded.
- Zone valves require a 24 vac transformer (no supplied by Buderus). 120 vac power source must be provided for transformer.
- Zone valves will open on a call for heat from their respective room thermostats. Zone valve end switched will pull in the pump relay to operate pump (PH-HK2).
- Power to the PH-HK2 circuit shall be interrupted under the following conditions:
  1)Condensate protection
  2)Outdoor temperature exceeds WWSD setpoint
- This application does not require a room sensor for radiant floor heating.

DHW Heating Operation:

- The tank sensor (FB) monitors domestic water temperature.
- 120v output from terminals 24 & 25 (PS) powers the DHW pump.
- During a call for DHW production the domestic pump (PS) is turned on and the space-heating circuit (PH-HK1) is turned off.
- After the DHW recharging and intelligent purge cycle is completed, the PS pump will be shut down and PH-HK1 circuit will be turned on.
- During the DHW cycle the PH-HK2 circuit remains on. The mixing valve can be set to either continue normal operation or fully close to prioritize DHW production. (Refer to the Ecomatic Service Manual for setting options)

4 Application Drawings

APPLICATION ECO-012 / MECHANICAL



Note: *This drawing is conceptual in nature and does not purport to address all design, installation or safety considerations. Additional safety and/or auxiliary equipment may be needed. This diagram is for reference use by officials, designers and licensed installers. It is expected that installers have an adequate knowledge of accepted industry practices for the equipment, procedures and applications involved.*

APPLICATION ECO-012 / MECHANICAL

DESCRIPTION:
Two Temperature Multi-Zone Radiant Floor Heating with FM241 module and Motorized Mixing Valve / Indirect DHW Heating

Space Heating Operation:
HK1 circuit (high temperature)

- System pump PH shall run continuously with the following exceptions:
  1)Condensate protection
  2)Outdoor temperature exceeds WWSD setpoint
  3)DHW priority
- The system pump may also shut down during the initial part of night setback period if a BF room sensor is being used for high temperature space heating.

To simplify this application, it is being shown without high temperature space heating. Refer to previous application diagrams for high temp heating.

HK2 circuit (mixed temperature)

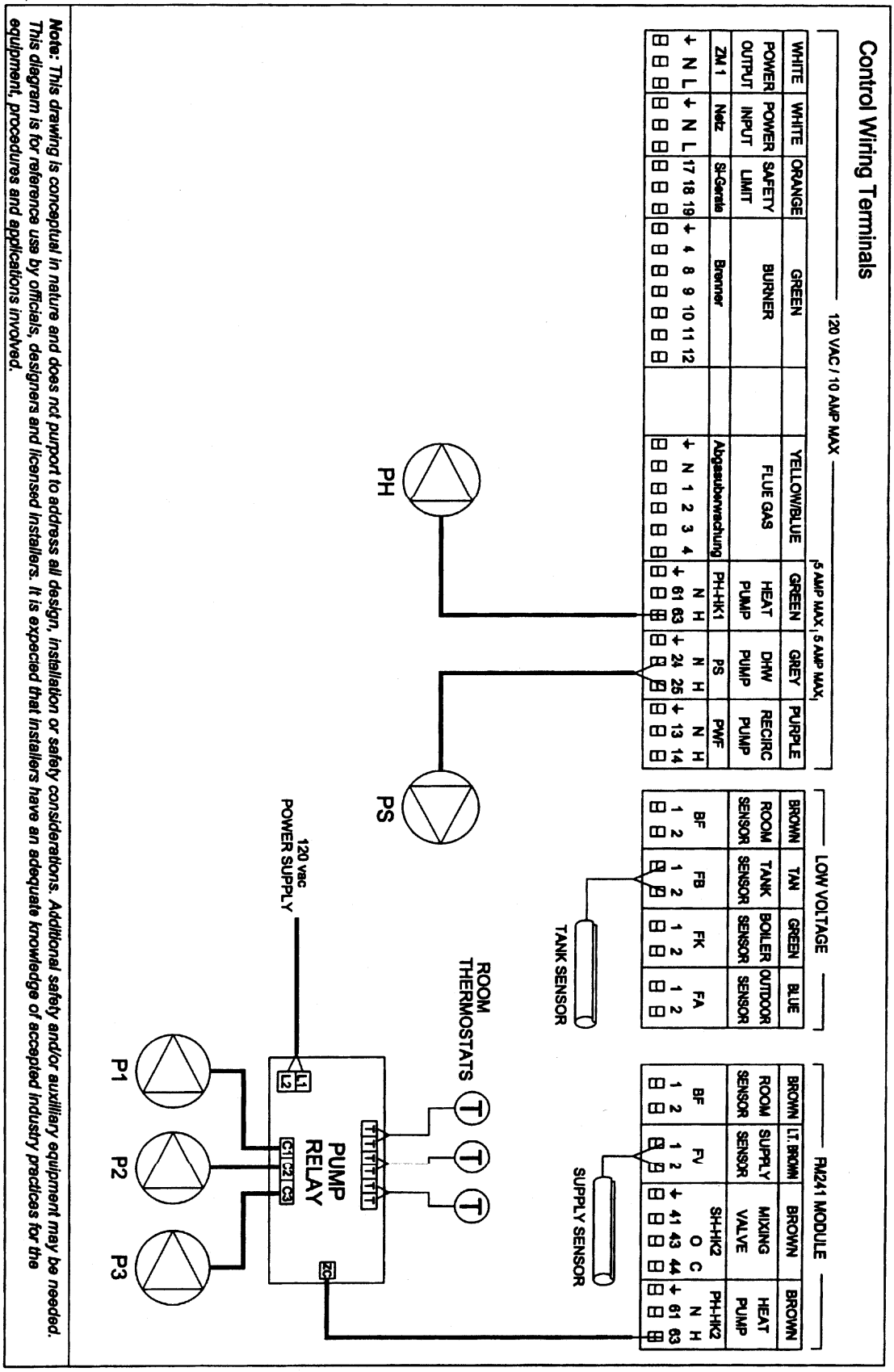
- Water temperature (1) is modulated based on the selected heating curve and input from the outdoor (FA) and supply (FV) sensors.
- The 4-way mixing valve modulates mixed water temperature (1) based on the selected heating curve with inputs from the supply sensor (FV) and the outdoor sensor (FA).
- The 3-way mixing valve is set manually and proportionately modulates water temperature based on the supply temperature from the 4-way valve.
- Space heating pumps (P1,P2,P3) require a multi-zone pump relay to operate on a call for heat from room thermostats.
- The PH-HK2 circuit shall be interrupted under the following conditions:
  1)Condensate protection
  2)Outdoor temperature exceeds WWSD setpoint
- This application does not require a room sensor for radiant floor heating.

DHW Heating Operation:

- The boiler temperature rises on a call for DHW for fast recovery.
- The control powers the domestic pump (PS) and the heating circuit (PH-HK1) is shut down.
- The PH-HK2 circuit will remain on during the DHW cycle. The mixing valve can be set to either continue normal operation or fully close to prioritize DHW production. (Refer to the Ecomatic Service Manual for setting options)
- After the DHW recharging and intelligent purge cycle is completed, the PS pump will be shut down and PH-HK1 circuit will be turned on.

4 Application Drawings

APPLICATION ECO-012 / ELECTRICAL



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APPLICATION ECO-012 / ELECTRICAL

DESCRIPTION:
Two Temperature Multi-Zone Radiant Floor Heating with FM241 and Motorized Mixing Valve / Indirect DHW Heating

Space Heating Operation:
HK1 circuit (high temperature)

- 120v output from terminals 61 & 63 (PH-HK1) provide power to the system pump (PH).

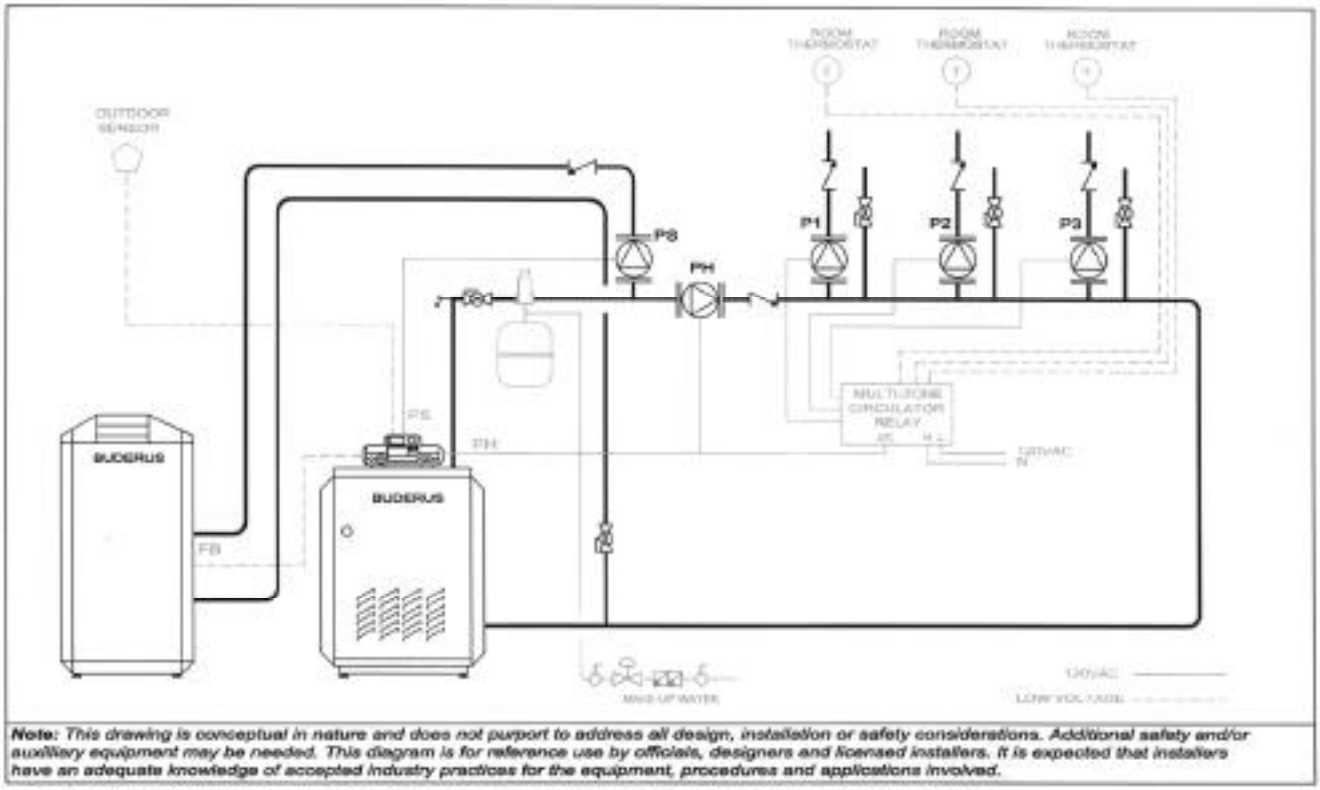
HK2 circuit (mixed temperature)

- Mixed water temperature (1) is maintained based on the selected heating curve (REF TEMP 2 and OFFSET 2) and inputs from the outdoor sensor (FA) and supply sensor (FV). Mixed water temperature (2) is proportionate to mixed temp (1).
- This application requires a multi-zone pump relay (not supplied by Buderus).
- 120v output from terminal 63 (PH-HK2) will energize the relay. The PH-HK2 circuit is limited to a 2 amp maximum load. Therefore, multi-pump applications require an additional source of 120v power to the pump relay. Generally the #63 terminal is wired to the ZC terminal on the relay panel, however relay circuitry can vary. Refer to wiring diagrams provided in this manual for specific manufacturer and model of the relay being used. If the model being used is not listed, contact Buderus for assistance.
- Each zone pump is energized on a call for heat from its respective room thermostat. The end switch of the relay panel is not used.
- Power to the PH-HK2 circuit shall be interrupted under the following conditions:
  1)Condensate protection
  2)Outdoor temperature exceeds WWSD setpoint
- This application does not require a room sensor for radiant floor heating.

DHW Heating Operation:

- The tank sensor (FB) monitors domestic water temperature.
- 120v output from terminals 24 & 25 (PS) powers the DHW pump.
- During a call for DHW production the domestic pump (PS) is turned on and the space-heating circuit (PH-HK1) is turned off.
- After the DHW recharging and intelligent purge cycle is completed, the PS pump will be shut down and PH-HK1 circuit will be turned on.
- During the DHW cycle the PH-HK2 circuit remains on. The mixing valve can be set to either continue normal operation or fully close to prioritize DHW production. (Refer to the Ecomatic Service Manual for setting options)

4 Application Drawings



APPLICATION ECO-013 / MECHANICAL

DESCRIPTION:
Multi-Zone Space Heating with Primary/Secondary Piping / Indirect DHW Heating

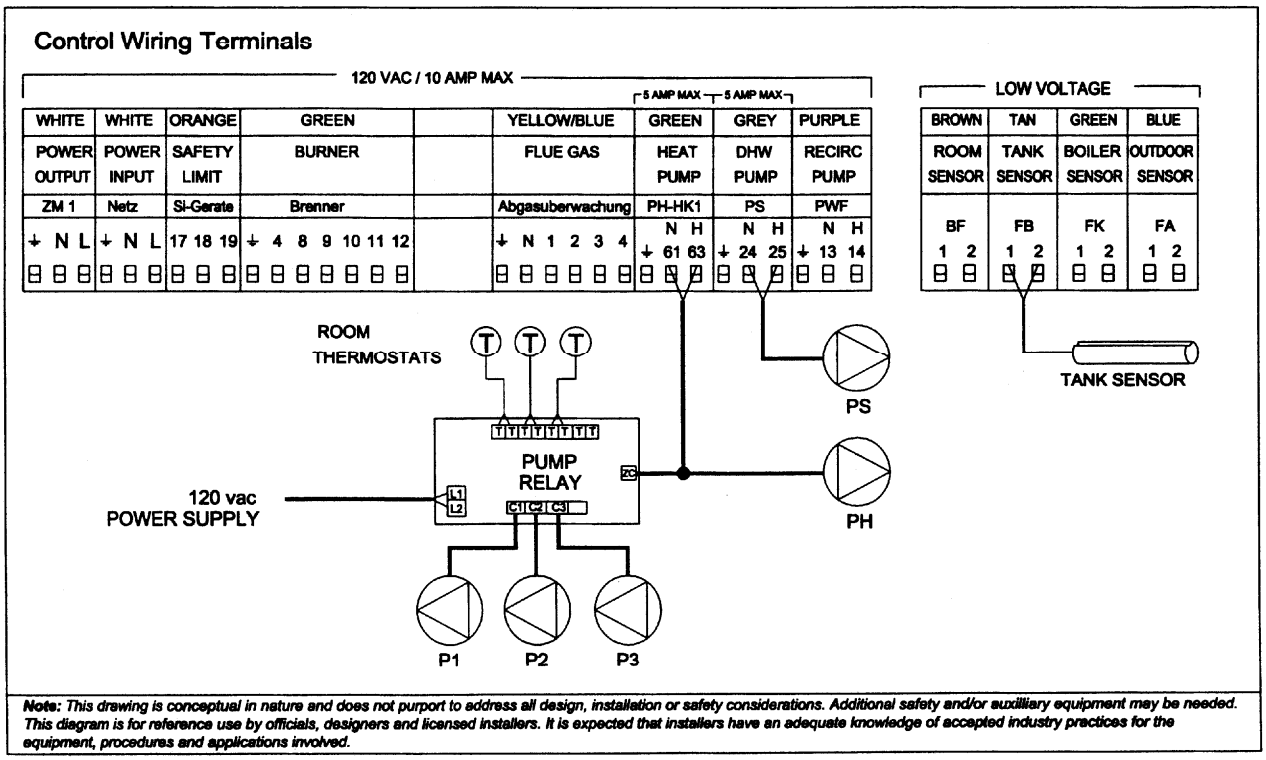
Space Heating Operation:

- Boiler temperature is maintained based on the selected heating curve and input from the outdoor sensor.
- During setback periods, the boiler temperature will be reduced based on the DAY TEMP and NIGHT TEMP settings on the Ecomatic control.
- Space heating pumps require a multi-zone switching relay to operate on a call for heat from a room thermostat.
- Power to the PH-HK1 circuit shall be interrupted under the following conditions:
  1)DHW priority
  2)Condensate protection
  3)Outdoor temperature exceeds WWSD setpoint
- This application does not require a room sensor.

Note: Standard primary/secondary piping practice requires a maximum spacing of 12î

DHW Heating Operation:

- The boiler temperature rises on a call for DHW for fast recovery.
- The control powers the domestic pump (PS) and the heating circuit (PH-HK1) is shut down.
- After the DHW recharging and intelligent purge cycle is completed, the PS pump will be shut down and PH-HK1 circuit will be turned on.



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APPLICATION ECO-013 / ELECTRICAL

DESCRIPTION:

Multi-Zone Zone Space Heating with Primary/Secondary Piping / Indirect DHW Heating

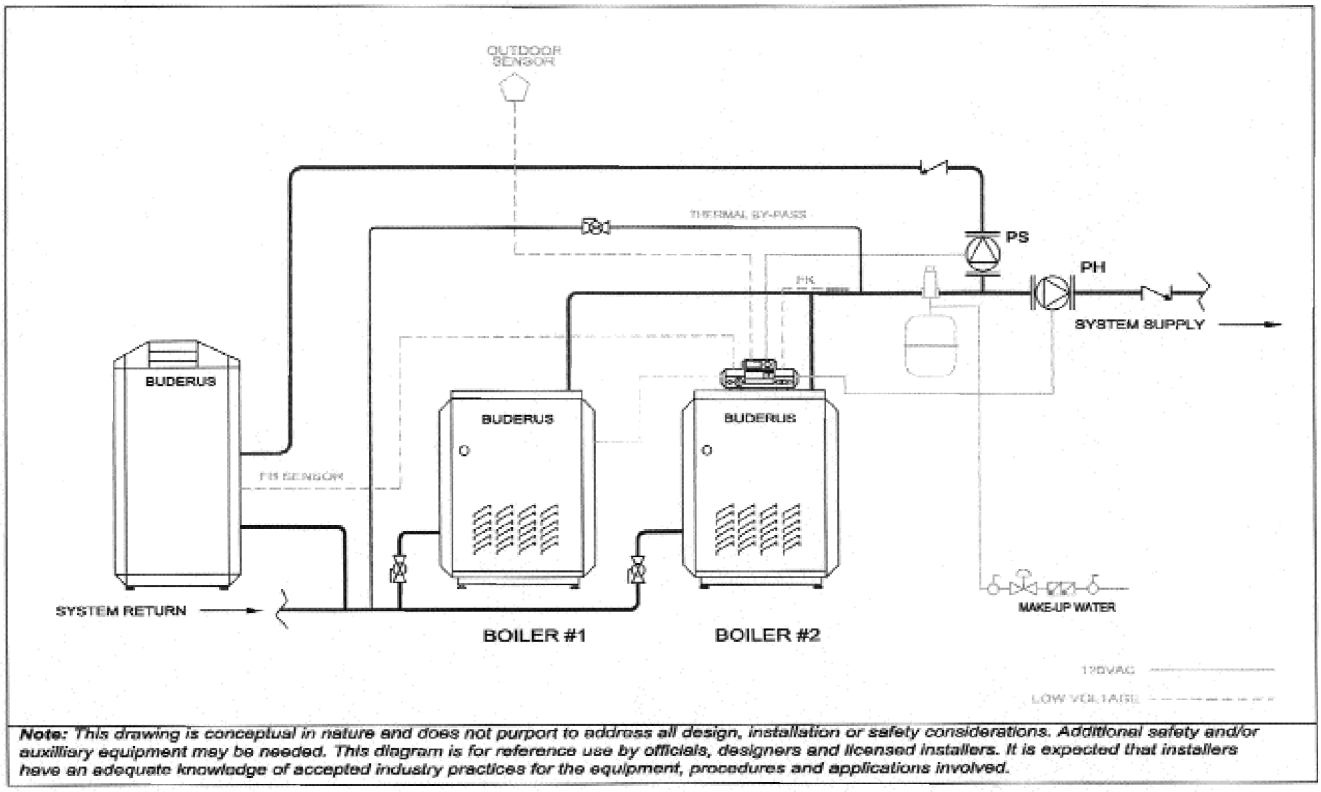
Space Heating Operation:

- Boiler temperature is maintained based on the selected heating curve (REF TEMP and OFFSET) and inputs from the outdoor sensor (FA) and boiler sensor (FK).
- This application requires a multi-zone pump relay (not supplied by Buderus).
- 120v output from terminal 63 (PH-HK1) will energize the relay. However, the PH-HK1 circuit is limited to a 5 amp maximum load. Therefore, multi-pump applications require an additional source of 120v power to the pump relay. Generally the #63 terminal is wired to the ZC terminal on the relay panel, however relay circuitry can vary. Refer to wiring diagrams provided in this manual for specific manufacturer and model of the relay being used. If the model being used is not listed, contact Buderus for assistance.
- Each zone pump is energized on a call for heat from its respective room thermostat. The end switch of the relay panel is not used.
- 120v output from terminals 61& 63 (PH-HK1) will provide power to the primary pump (PH)
- Power to the PH-HK1 circuit shall be interrupted under the following conditions:
  1)DHW priority
  2)Condensate protection
  3)Outdoor temperature exceeds WWSD setpoint
- This application does not require a room sensor.

DHW Heating Operation:

- The tank sensor (FB) monitors domestic water temperature.
- 120v output from terminals 24 & 25 (PS) powers the DHW pump.
- During a call for DHW production the domestic pump (PS) is turned on and the space-heating circuit (PH-HK1) is turned off.
- After the DHW recharging and intelligent purge cycle is completed, the PS pump will be shut down and PH-HK1 circuit will be turned on.

4 Application Drawings



APPLICATION ECO-014 / MECHANICAL

DESCRIPTION:
Parallel Boiler Piping using FM242 module / Indirect DHW Heating

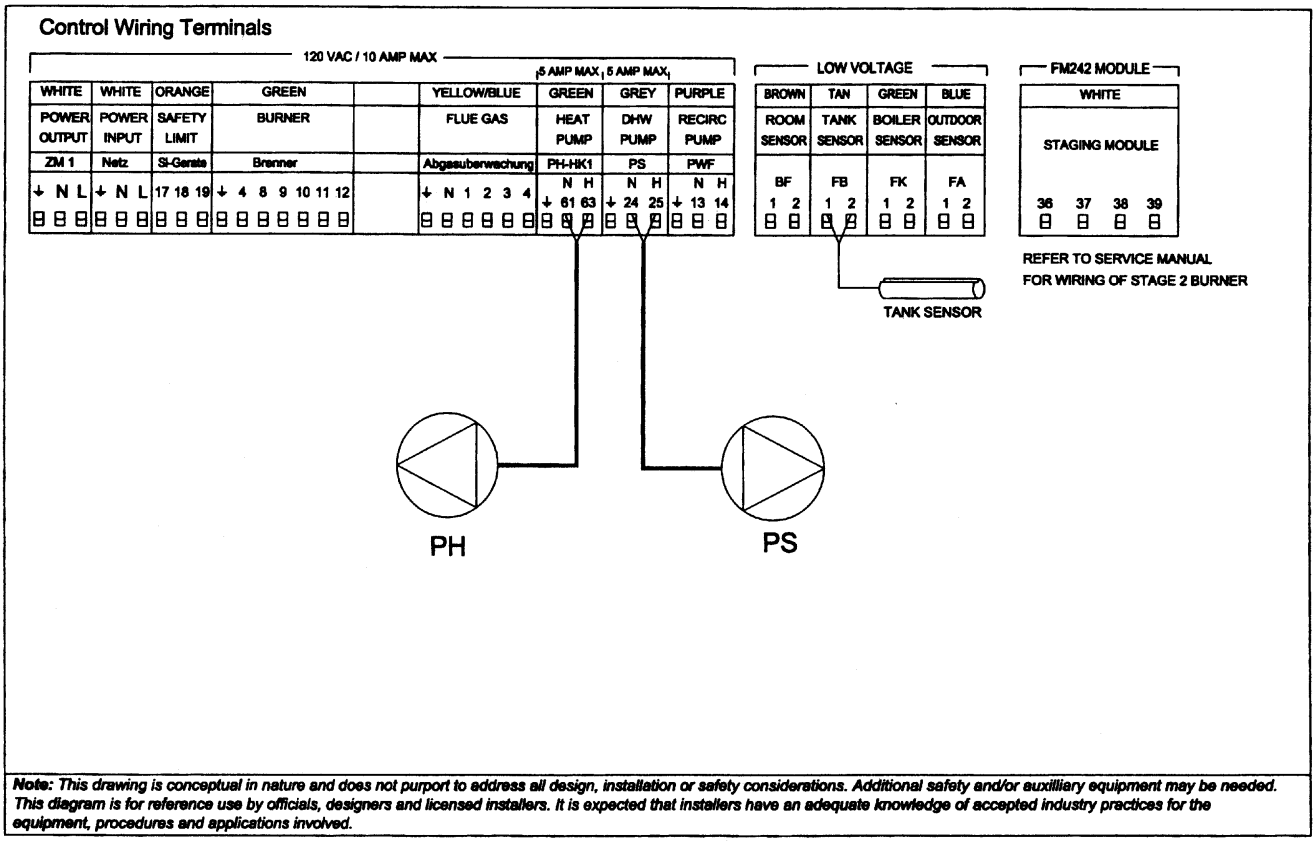
Space Heating Operation:

- System temperature is maintained based on the selected heating curve and input from the outdoor sensor.
- During setback periods, the boiler temperature will be reduced based on the DAY TEMP and NIGHT TEMP settings on the Ecomatic control.
- Power to the PH circuit shall be interrupted under the following exceptions:
  1)DHW priority
  2)Condensate protection
  3)Outdoor temperature exceeds WWSD setpoint

DHW Heating Operation:

- The system temperature rises on a call for DHW for fast recovery.
- The control powers the domestic pump (PS) and the heating circuit (PH) is shut down.
- After the DHW recharging and intelligent purge cycle is completed, the PS pump will be shut down and PH circuit will be turned on.

Notes: 1) Boilers shall be piped in a reverse return arrangement to ensure equal flow through each boiler.
2) A small thermal bypass shall be installed immediately after the FK supply sensor in order to create flow past the sensor when the system pump (PH) is off.



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APPLICATION ECO-014 / ELECTRICAL

DESCRIPTION:

2-stage boiler operation / Parallel Piping / Indirect DHW Heating

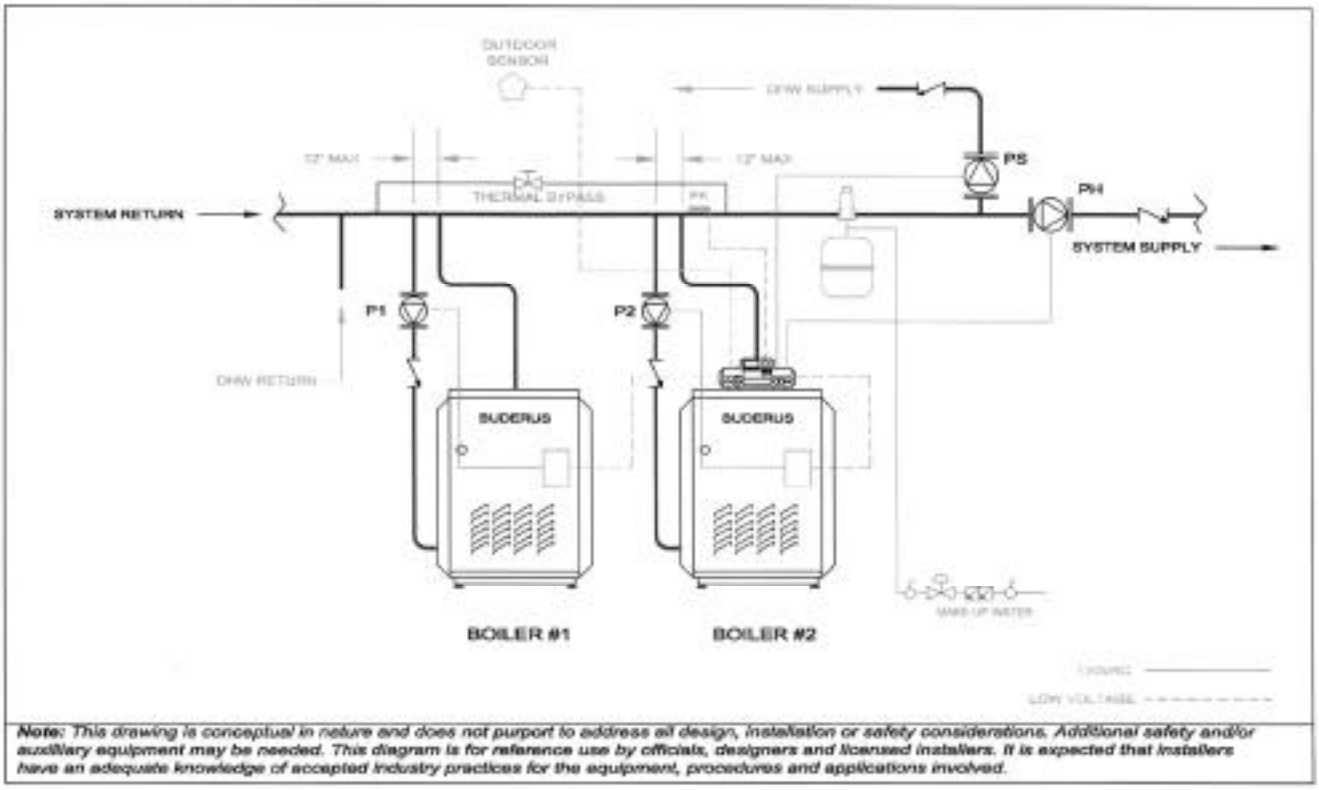
Space Heating Operation:

- System temperature is maintained based on the selected heating curve (REF TEMP and OFFSET) and inputs from the outdoor sensor (FA) and supply sensor (FK).
- This application requires optional staging module FM242.
- The control will stage either one or two boilers to maintain the desired set point. Refer to control Service Manual for wiring information for burners.
- 120v output from terminals 61 & 63 (PH-HK1) provides power to system pump (PH).
- Power to the PH-HK1 circuit shall be interrupted under the following conditions:
  1)DHW priority
  1)Condensate protection
  1)Outdoor temperature exceeds WWSD setpoint

DHW Heating Operation:

- The tank sensor (FB) monitors domestic water temperature.
- 120v output from terminals 24 & 25 (PS) powers the DHW pump.
- During a call for DHW production the domestic pump (PS) is turned on and the space-heating circuit (PH) is turned off.
- After the DHW recharging and intelligent purge cycle is completed, the PS pump will be shut down and PH circuit will be turned on.

4 Application Drawings



Note: This drawing is conceptual in nature and does not purport to address all design, installation or safety considerations. Additional safety and/or auxiliary equipment may be needed. This diagram is for reference use by officials, designers and licensed installers. It is expected that installers have an adequate knowledge of accepted industry practices for the equipment, procedures and applications involved.

APPLICATION ECO-015 / MECHANICAL

DESCRIPTION:
Dual Boiler / Primary/Secondary Boiler Piping using FM242 module / Indirect DHW Heating

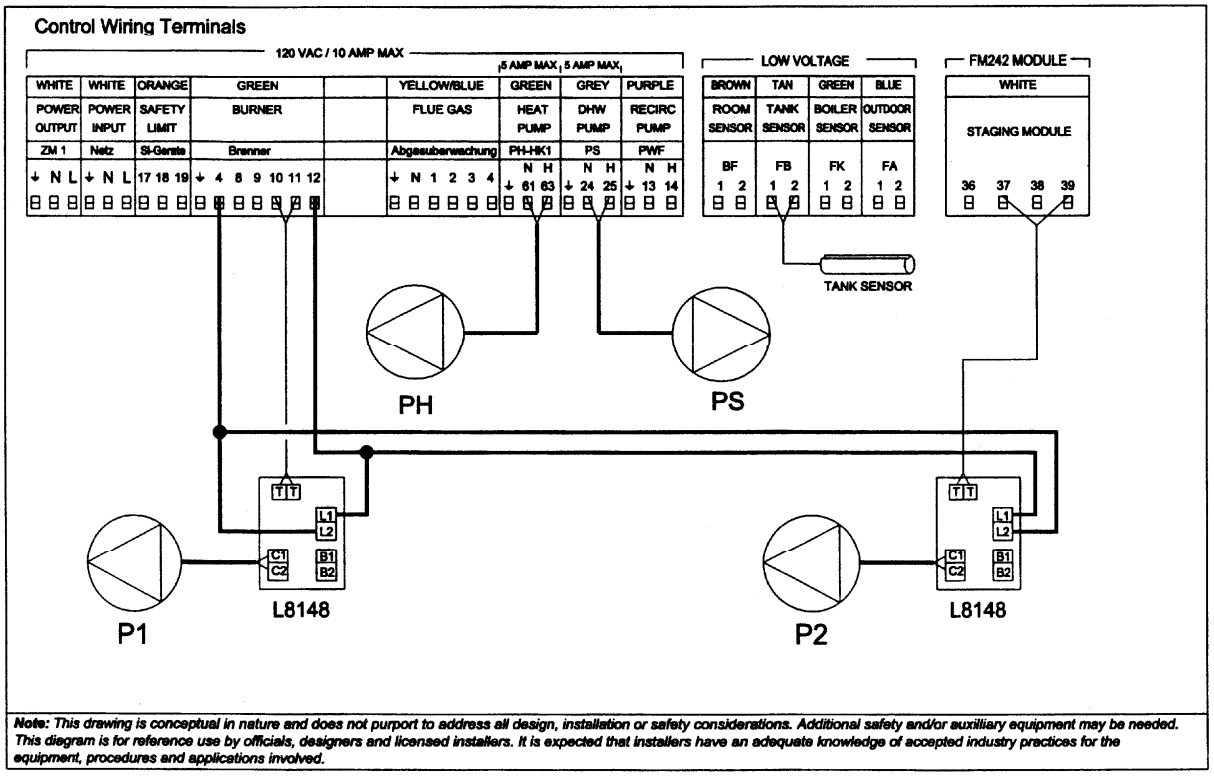
Space Heating Operation:

- The primary loop temperature is maintained based on the selected heating curve and input from the outdoor sensor.
- During setback periods, the system temperature will be reduced based on the DAY TEMP and NIGHT TEMP settings on the Buderus control.
- Boiler pumps (P1, P2) shall be wired to the Honeywell L8148 aquastat and will operate on a demand signal from the Ecomatic control.
- The primary pump (PH) shall be powered continuously with the following exceptions:
  1)DHW priority
  2)Condensate protection
  3)Outdoor temperature exceeds WWSD setpoint

DHW Heating Operation:

- The system temperature rises on a call for DHW for fast recovery.
- The control powers the domestic pump (PS) and the heating circuit (PH) is shut down.
- After the DHW recharging and intelligent purge cycle is completed, the PS pump will be shut down and PH circuit will be turned on.

Notes: 1) Boilers shall be piped in primary/secondary arrangement with a recommended spacing of 4 pipe diameters with a maximum of 12î between the supply and return to the primary loop.
2) A small thermal bypass shall be installed immediately after the FK supply sensor in order to create flow past the sensor when the system pump (PH) is off.



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APPLICATION ECO-015 / ELECTRICAL

DESCRIPTION:

2-stage boiler operation using FM242 module / Primary-Secondary Piping / Indirect DHW Heating

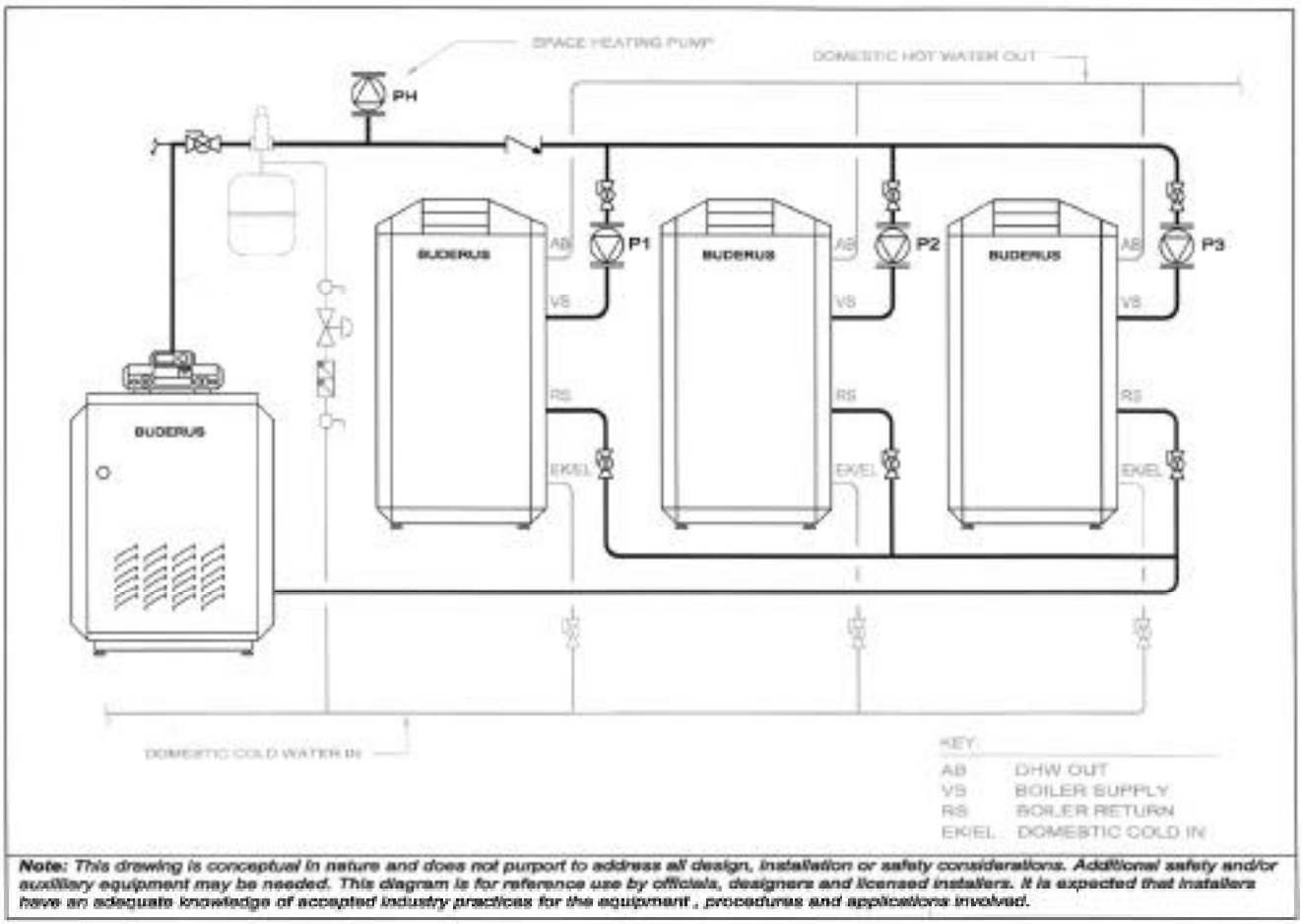
Space Heating Operation:

- Primary loop temperature is maintained based on the selected heating curve (REF TEMP and OFFSET) and inputs from the outdoor sensor (FA) and supply sensor (FK).
- This application requires optional staging module FM242.
- The control will stage either one or two boilers to maintain the desired set point. Refer to control Service Manual for wiring information for burners.
- This electrical diagram addresses only boilers using an operating aquastat/relay with a pump circuit (ex: Honeywell L8148). Both boilers require an L8148 operating control. If this type of aquastat is not being used, please contact Buderus for assistance.
- Boiler pumps (P1 and P2) shall be wired to the L8148 control and will operate on a heat demand signal from the Buderus control.
- 120v output from terminals 61 & 63 (PH-HK1) provides power to system pump (PH).
- Power to the PH-HK1 circuit shall be interrupted under the following conditions:
  1)DHW priority
  2)Condensate protection
  3)Outdoor temperature exceeds WWSD setpoint

DHW Heating Operation:

- The tank sensor (FB) monitors domestic water temperature.
- 120v output from terminals 24 & 25 (PS) powers the DHW pump.
- During a call for DHW production the domestic pump (PS) is turned on and the space-heating circuit (PH) is turned off.
- After the DHW recharging and intelligent purge cycle is completed, the PS pump will be shut down and PH circuit will be turned on.

4 Application Drawings



APPLICATION ECO-016 / MECHANICAL

DESCRIPTION:
Indirect DHW Heating with Multiple Tanks (Parallel Piping)

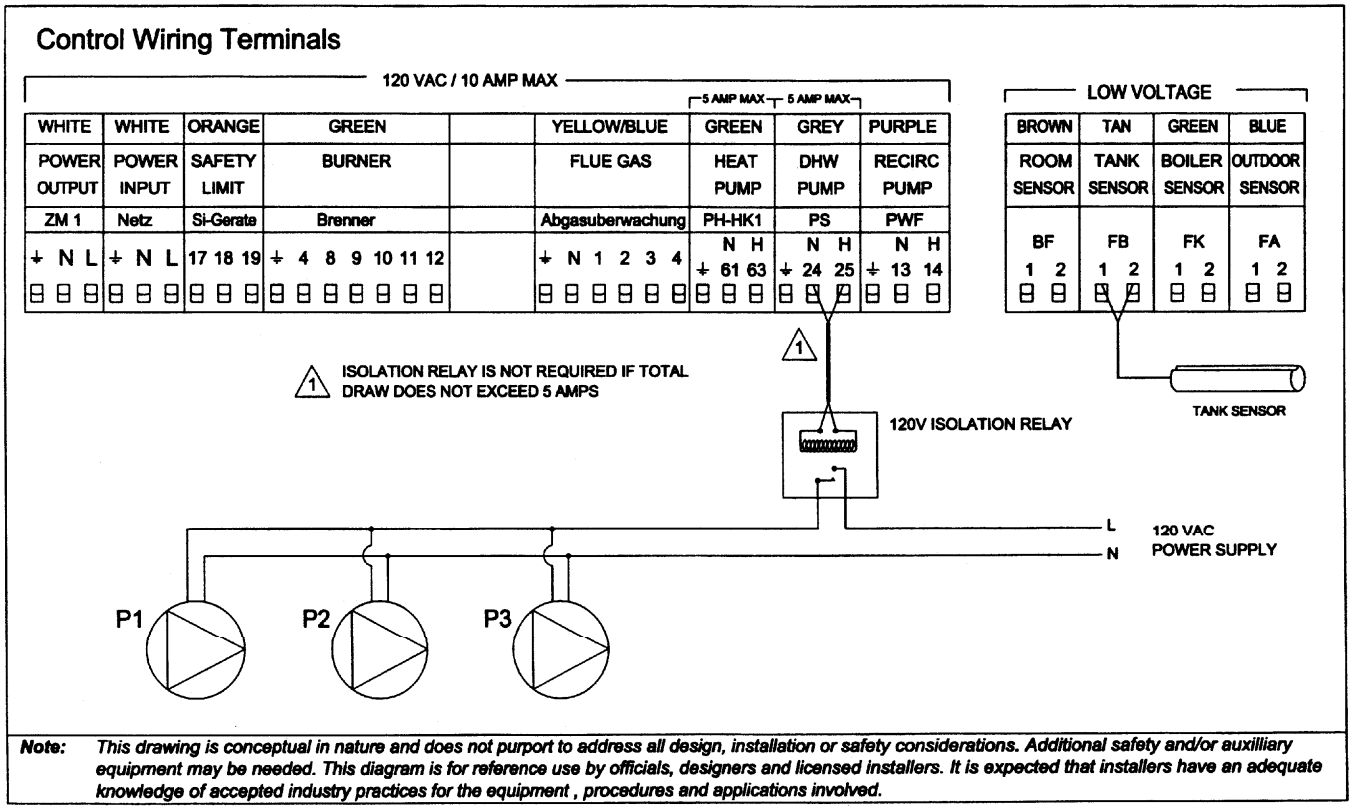
Space Heating Operation:
Refer to previous application drawings for information on space heating.

DHW HEATING:
Piping:

- It is important that the tanks be piped in a reverse return arrangement on both the boiler side and the domestic water side. This will ensure equal flow through each tank allowing DHW to draw down and recharge at the same rate.
- It is recommended that each tank have its own pump.
- Install a flow check valve on the common supply piping.

Operation:

- The boiler temperature rises on a call for DHW for fast recovery.
- The control powers the domestic pumps P1, P1, P3 and the heating circuit (PH) is shut down.
- After the DHW recharging and intelligent purge cycle is completed, the DHW pump circuit (PS) will be shut down and PH circuit will be turned on.



Note: *This drawing is conceptual in nature and does not purport to address all design, installation or safety considerations. Additional safety and/or auxilliary equipment may be needed. This diagram is for reference use by officials, designers and licensed installers. It is expected that installers have an adequate knowledge of accepted industry practices for the equipment, procedures and applications involved.*

APPLICATION ECO-016 / ELECTRICAL

DESCRIPTION:

Indirect DHW Heating with Multiple Tanks (Parallel Piping)

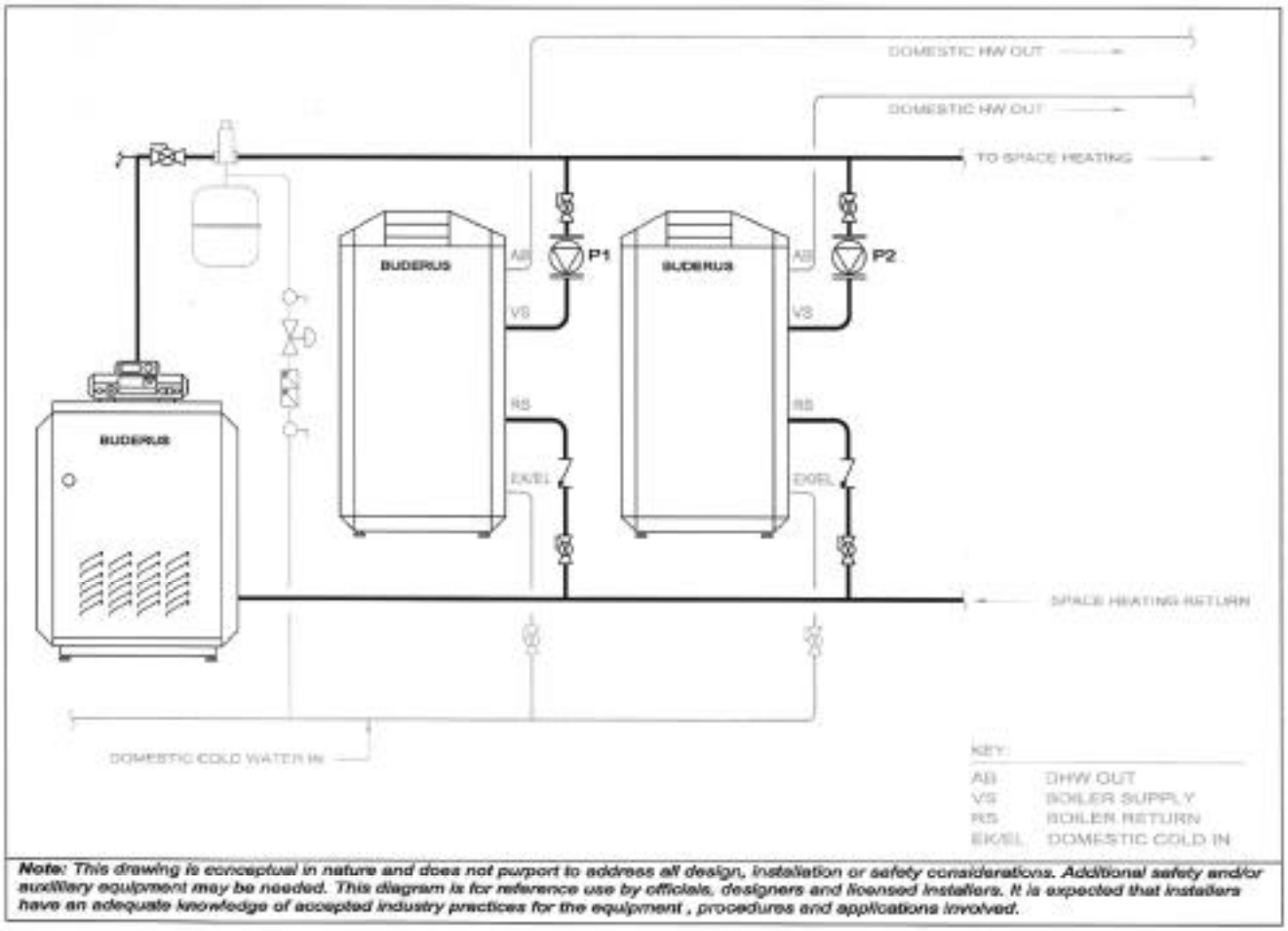
Space Heating Operation:

- Refer to previous application drawings for information on space heating.

DHW Heating Operation:

- The tank sensor (FB) monitors domestic water temperature.
- FB tank sensor can be located in any one of the DHW tanks.
- 120v output from terminals 24 & 25 (PS) provides power for the DHW circuit.
- 120v isolation relay will be required if the total draw exceeds 5 amps.
- During a call for DHW production the domestic circuit (PS) is turned on and the space-heating circuit (PH) is turned off.
- After the DHW recharging and intelligent purge cycle is completed, the PS circuit will be shut down and PH circuit will be turned on.

4 Application Drawings



APPLICATION ECO-017 / MECHANICAL

DESCRIPTION:
Indirect DHW Heating with Two Tanks (Priority Load)

Space Heating Operation:

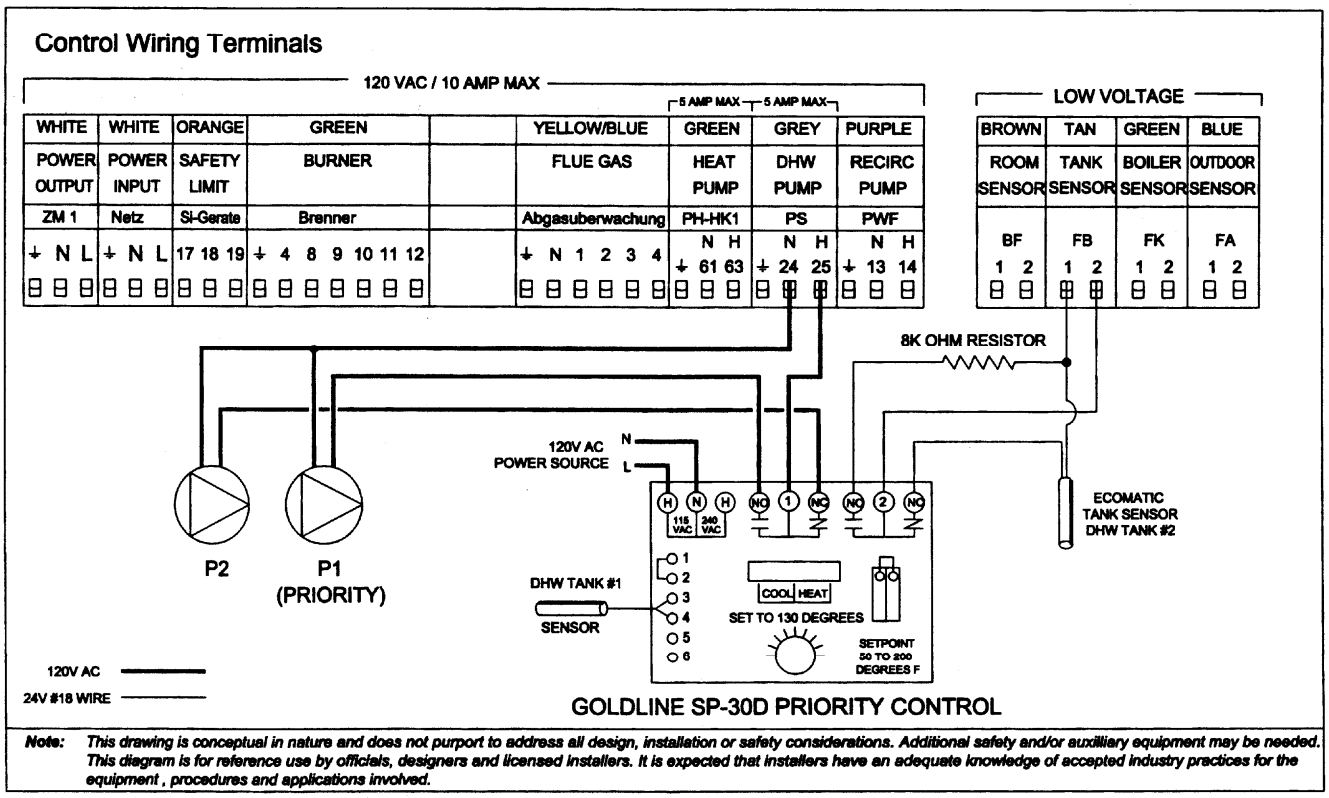
- Refer to previous application drawings for information on space heating.

DHW HEATING:

- Piping:
- This piping arrangement allows the tanks to be remotely located.
- Tanks can maintain different temperatures with one tank having priority.
- Each tank must have its own pump.
- Install a flow check for each tank.

Operation:

- The boiler temperature rises on a call for DHW for fast recovery.
- The control powers the domestic pump P1 or P2 and the heating circuit (PH) is shut down.
- Tank #1 must recharge within 30 minutes or the control will go back to space heating and display a DHW ERROR.
- After the DHW recharging and intelligent purge cycle is completed, the DHW pump circuit (PS) will be shut down and PH circuit will be turned on.



Note: This drawing is conceptual in nature and does not purport to address all design, installation or safety considerations. Additional safety and/or auxiliary equipment may be needed. This diagram is for reference use by officials, designers and licensed installers. It is expected that installers have an adequate knowledge of accepted industry practices for the equipment, procedures and applications involved.

APPLICATION ECO-017 / ELECTRICAL

DESCRIPTION:

Indirect DHW Heating with Two Tanks (Priority Load)

Space Heating Operation:

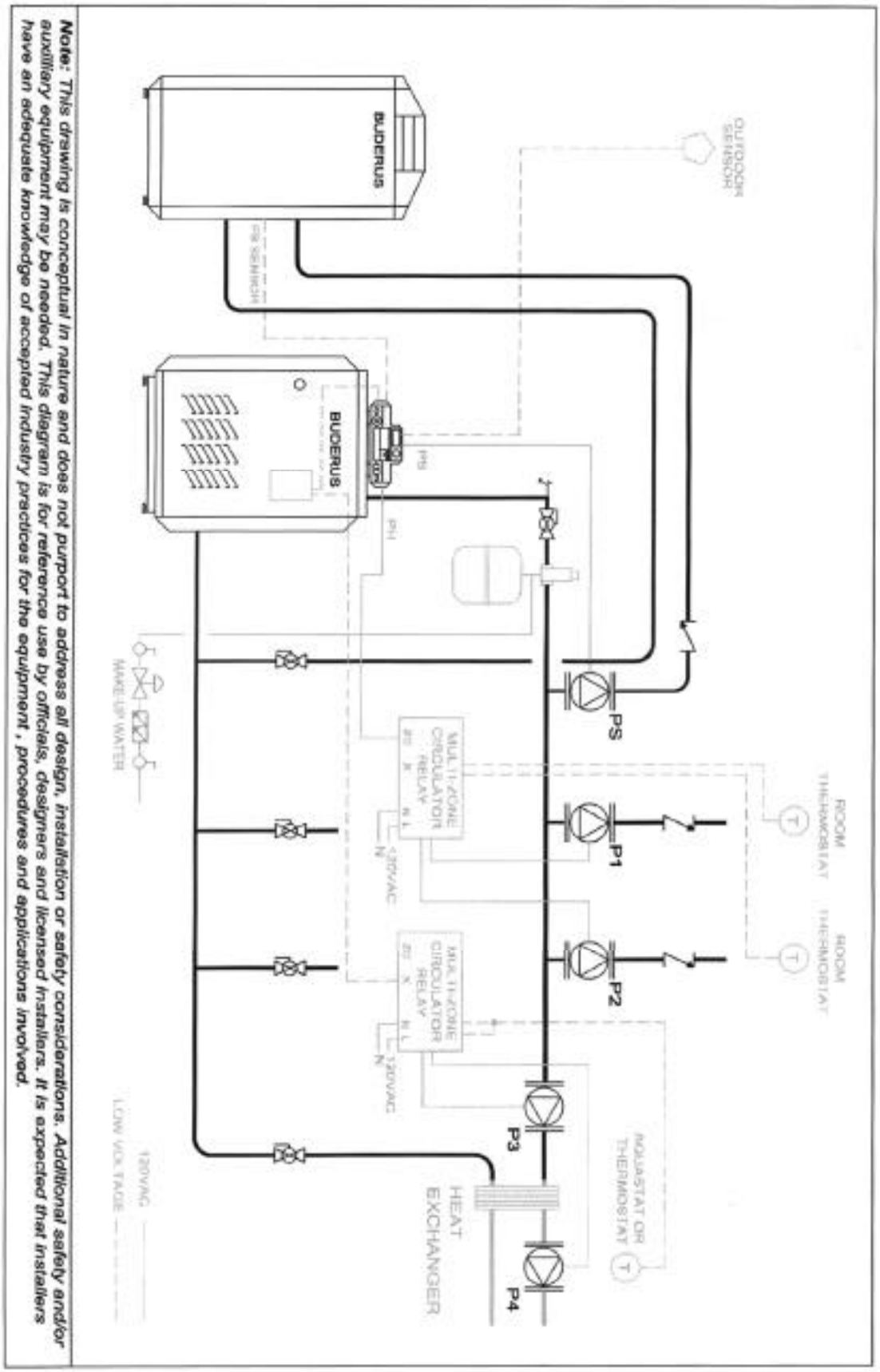
- Refer to previous application drawings for information on space heating.

DHW Heating Operation:

- One (1) Goldline SP-30D (or equal) priority aquastat is required for this application.
- (SP-30D control is available through Buderus)
- One 8K to 10K OHM resistor is required. (Not supplied by Buderus)
- The SP-30D tank sensor monitors domestic water temperature in tank #1.
- The tank sensor (FB) monitors domestic water temperature in tank #2.
- Both tanks will have priority over space heating. Tank #1 will have priority over tank #2.
- Due to a freeze protection feature in the Buderus reset control, tank #1 must recharge within 30 minutes or the system will go back to space heating and display a DHW error message.
- 120v output from terminals 24 & 25 (PS) provides power for the DHW pump(s).
- Provide 120v power to SP-30D control.
- During a call for DHW production the domestic circuit (PS) is turned on and the space-heating circuit (PH) is turned off.
- After the DHW recharging and intelligent purge cycle is completed, the PS circuit will be shut down and PH circuit will be turned on.

4 Application Drawings

APPLICATION ECO-018 / MECHANICAL



Note: *This drawing is conceptual in nature and does not purport to address all design, installation or safety considerations. Additional safety and/or auxiliary equipment may be needed. This diagram is for reference use by officials, designers and licensed installers. It is expected that installers have an adequate knowledge of accepted industry practices for the equipment , procedures and applications involved.*

APPLICATION ECO-018 / MECHANICAL

DESCRIPTION:
Multi-Zone Space Heating / On-demand High Temp Heating / Indirect DHW Heating

Space Heating Operation:

- Boiler temperature is maintained based on the selected heating curve and input from the outdoor sensor.
- Boiler will run to high limit on call from on-demand heat zone.
- During setback periods, the boiler temperature will be reduced based on the DAY TEMP and NIGHT TEMP settings on the Ecomatic control.
- Space heating pumps require a multi-zone switching relay to operate on a call for heat from a room thermostat.
- On-demand zone requires a separate switching relay in order to fire the boiler on a call for heat.
- Power to the PH-HK1 circuit shall be interrupted under the following conditions:
  1)DHW priority
  2)Condensate protection
  3)Outdoor temperature exceeds WWSD setpoint

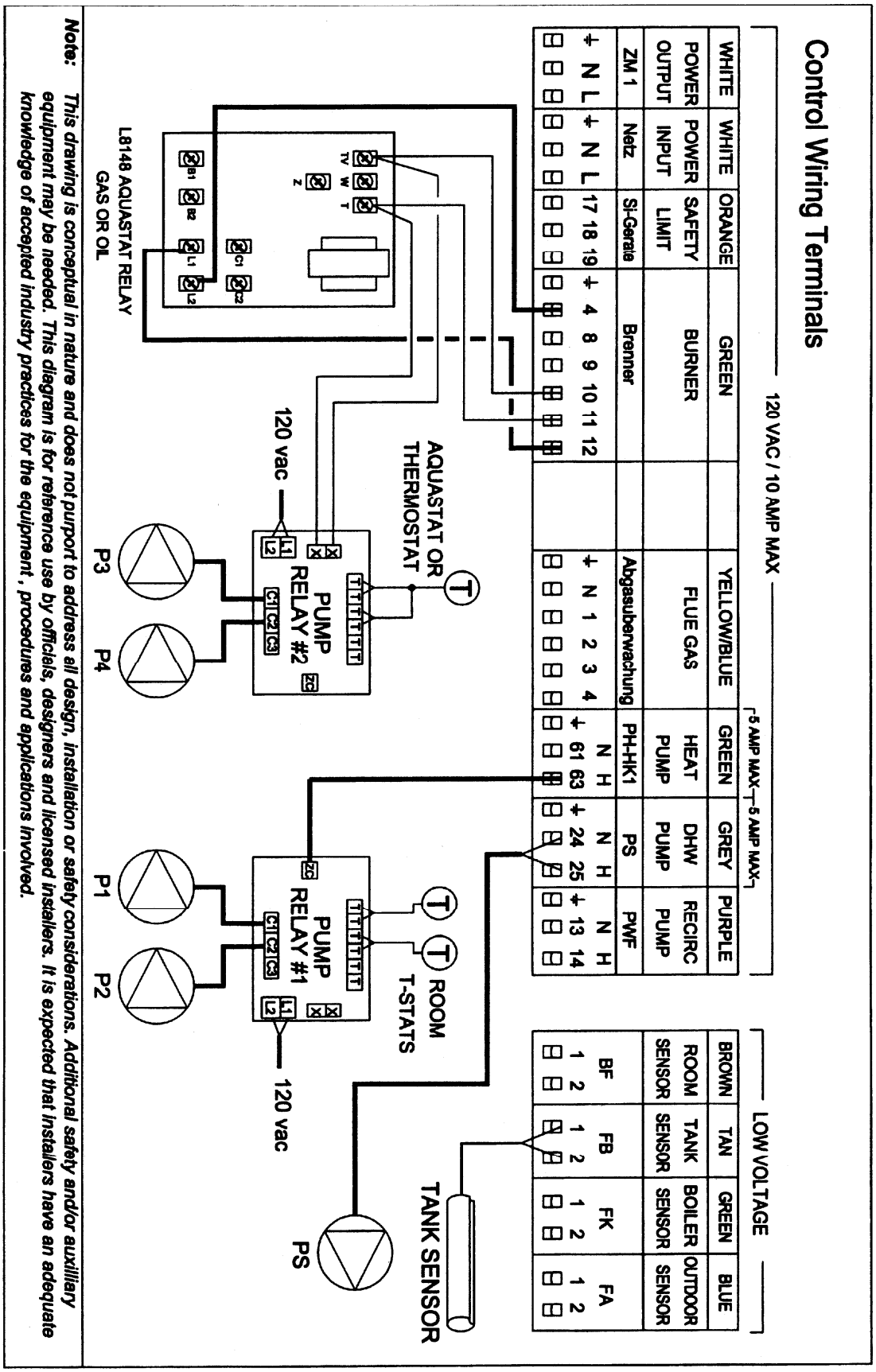
Note - As shown, the on-demand zone is interrupted during DHW priority, WWSD and condensate protection. For year round, 24-hour operation of the on-demand zones, disconnect the PH-HK1 connection from ZC on the pump relay. This will allow the on-demand zone to operate during DHW recharging cycles. Consideration to boiler sizing must be given.

DHW Heating Operation:

- The boiler temperature rises on a call for DHW for fast recovery.
- The control powers the domestic pump (PS) and the heating circuit (PH-HK1) is shut down.
- After the DHW recharging and intelligent purge cycle is completed, the PS pump will be shut down and PH-HK1 circuit will be turned on.

4 Application Drawings

APPLICATION ECO-018 / ELECTRICAL



Note: *This drawing is conceptual in nature and does not purport to address all design, installation or safety considerations. Additional safety and/or auxillary equipment may be needed. This diagram is for reference use by officials, designers and licensed installers. It is expected that installers have an adequate knowledge of accepted industry practices for the equipment, procedures and applications involved.*

APPLICATION ECO-018 / ELECTRICAL

DESCRIPTION:
Multi-zone Space Heating / On-demand High Temp Heating / Indirect DHW Heating

Space Heating Operation:

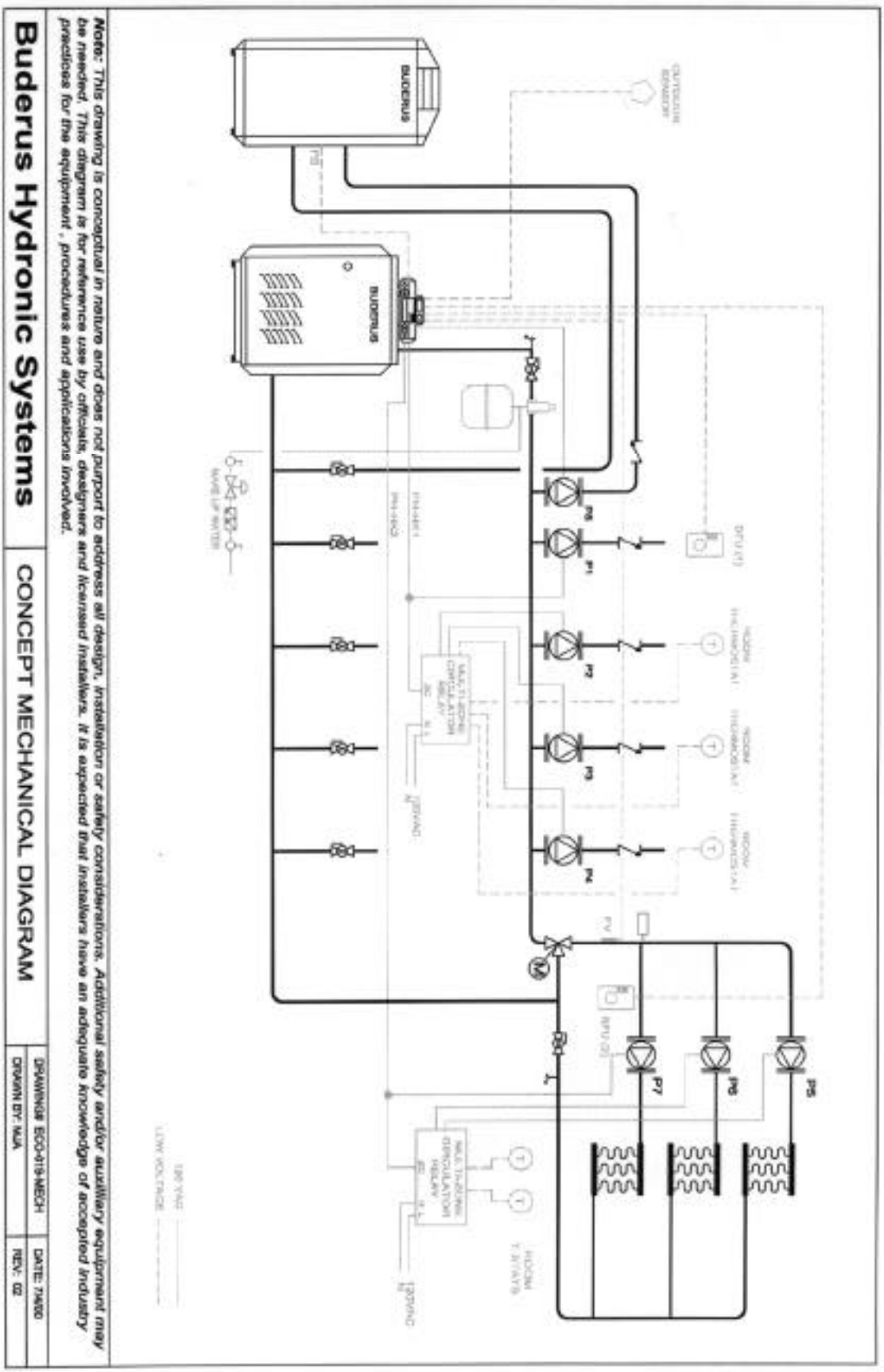
- Boiler temperature is maintained based on the selected heating curve (REF TEMP and OFFSET) and inputs from the outdoor sensor (FA) and boiler sensor (FK).
- Boiler will run to limit set on L8148 aquastat on a call for heat from on-demand zone(s).
- This application requires a multi-zone pump relay (not supplied by Buderus). The on-demand zone also requires a separate pump relay to fire the boiler on a call for heat. When using a heat exchanger as shown, pumps P3 and P4 must run simultaneously. The demand signal from the on-demand zone(s) (aquastat, thermostat or end switch) must be wired to turn both pumps on.
- 120v output from terminal 63 (PH-HK1) will energize pump relay #1. However, the PH-HK1 circuit is limited to a 5 amp maximum load. Therefore, multi-pump applications require an additional source of 120v power to the pump relay. Generally the #63 terminal is wired to the ZC terminal on the relay panel, however relay circuitry can vary. Refer to wiring diagrams provided in this manual for specific manufacturer and model of the relay being used. If the model being used is not listed, contact Buderus for assistance.
- Each zone pump is energized on a call for heat from its respective room thermostat. The end switch of relay panel #1 is not used for regular space heating zones. The end switch of the on-demand zone(s) relay (#2) is wired to T / TV on the L8148 aquastat.
- Power to the pump relay #1shall be interrupted under the following conditions:
  1)DHW priority
  2)Condensate protection
  3)Outdoor temperature exceeds WWSD setpoint

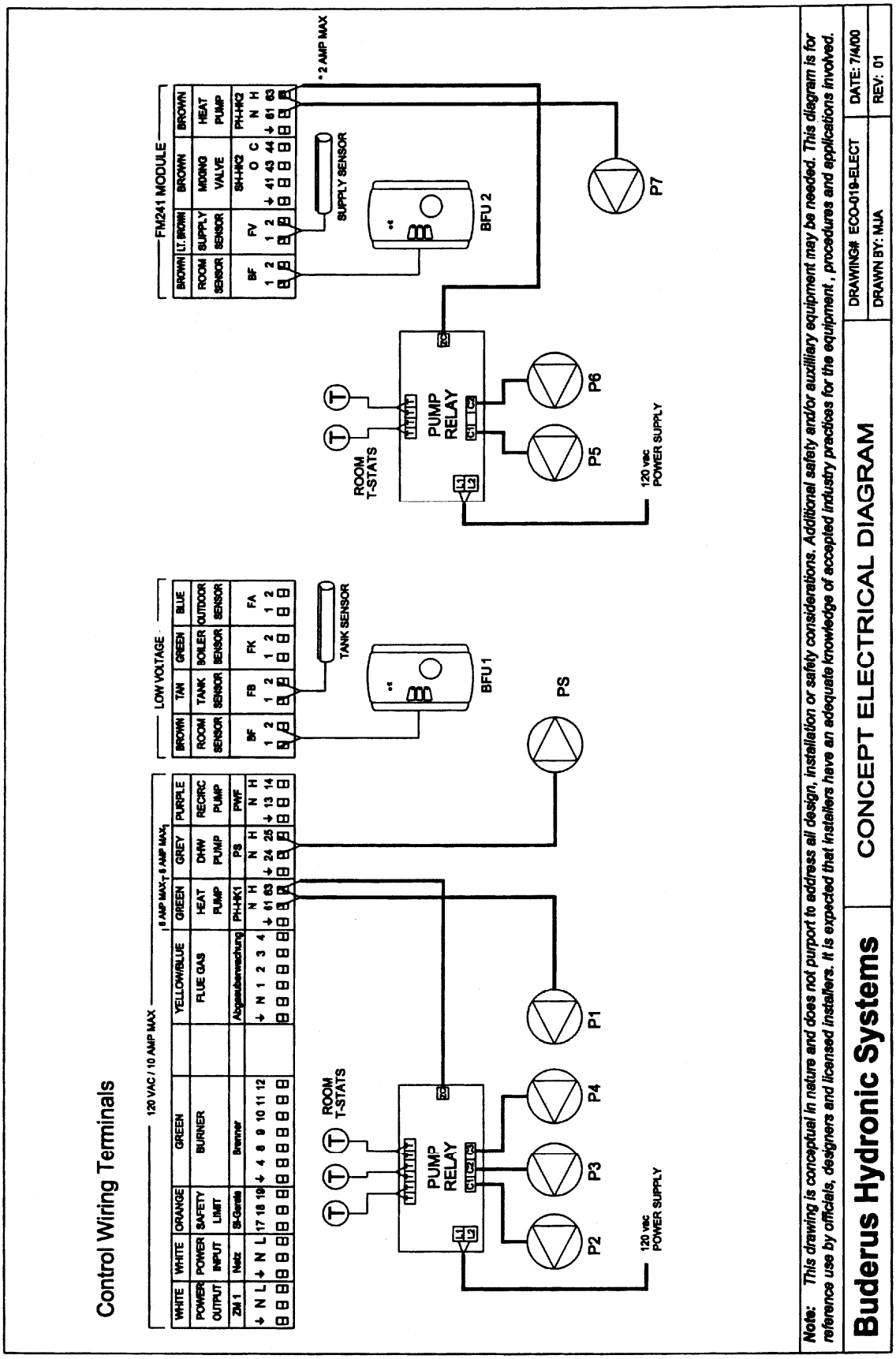
- For year round, 24-hour operation of the on-demand zone(s), do not connect the PH-HK1 to ZC on pump relay #2.
- In order to use a room sensor with this type of application, a standard room thermostat must also be used in the same zone in order to prevent overheating when the on-demand zone is calling.

DHW Heating Operation:

- The tank sensor (FB) monitors domestic water temperature.
- 120v output from terminals 24 & 25 (PS) powers the DHW pump.
- During a call for DHW production the domestic pump (PS) is turned on and the space-heating circuit (PH-HK1) is turned off.
- After the DHW recharging and intelligent purge cycle is completed, the PS pump will be shut down and PH-HK1 circuit will be turned on.

4 Application Drawings

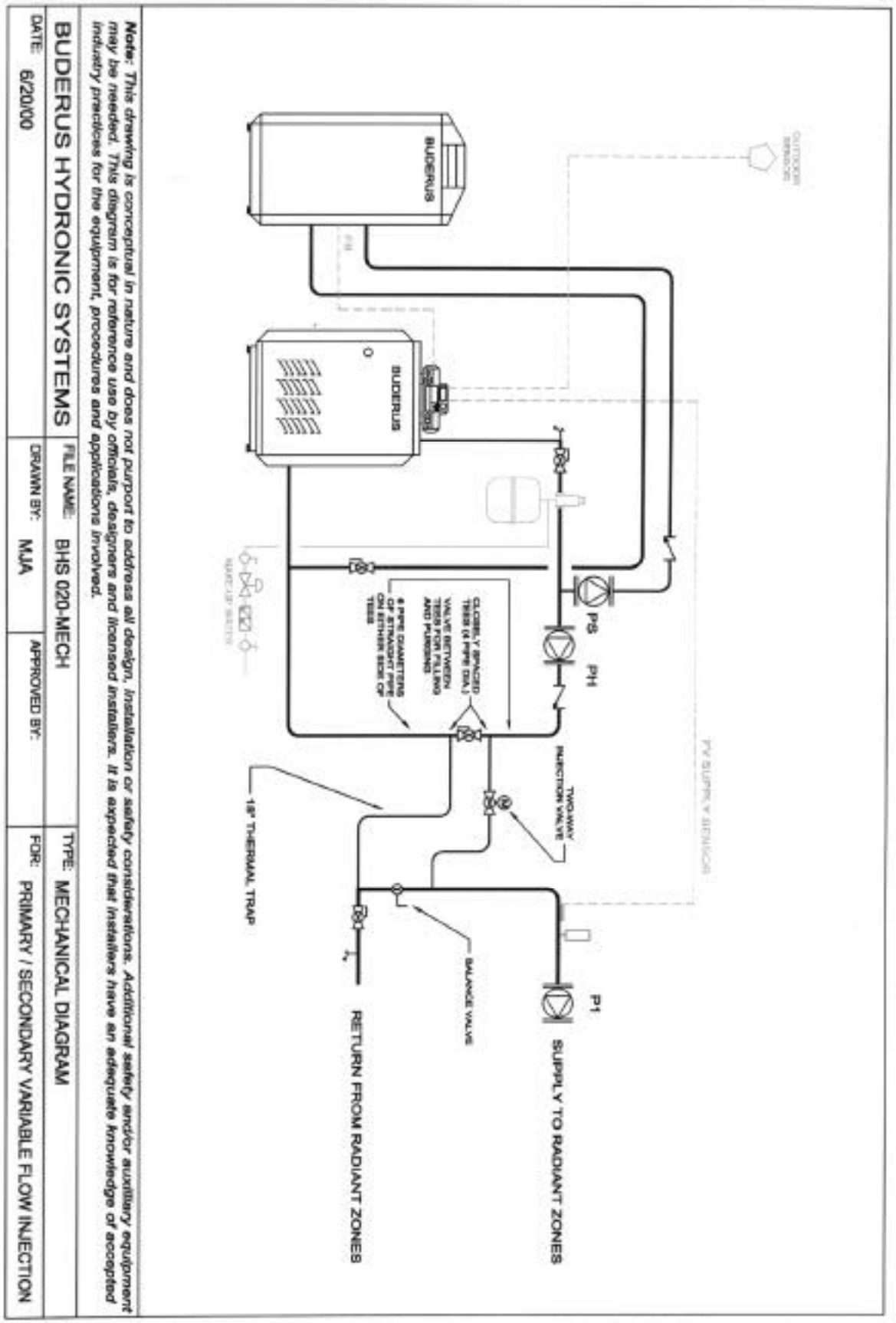




Note: This drawing is conceptual in nature and does not purport to address all design, installation or safety considerations. Additional safety and/or auxiliary equipment may be needed. This diagram is for reference use by officials, designers and licensed installers. It is expected that installers have an adequate knowledge of accepted industry practices for the equipment, procedures and applications involved.

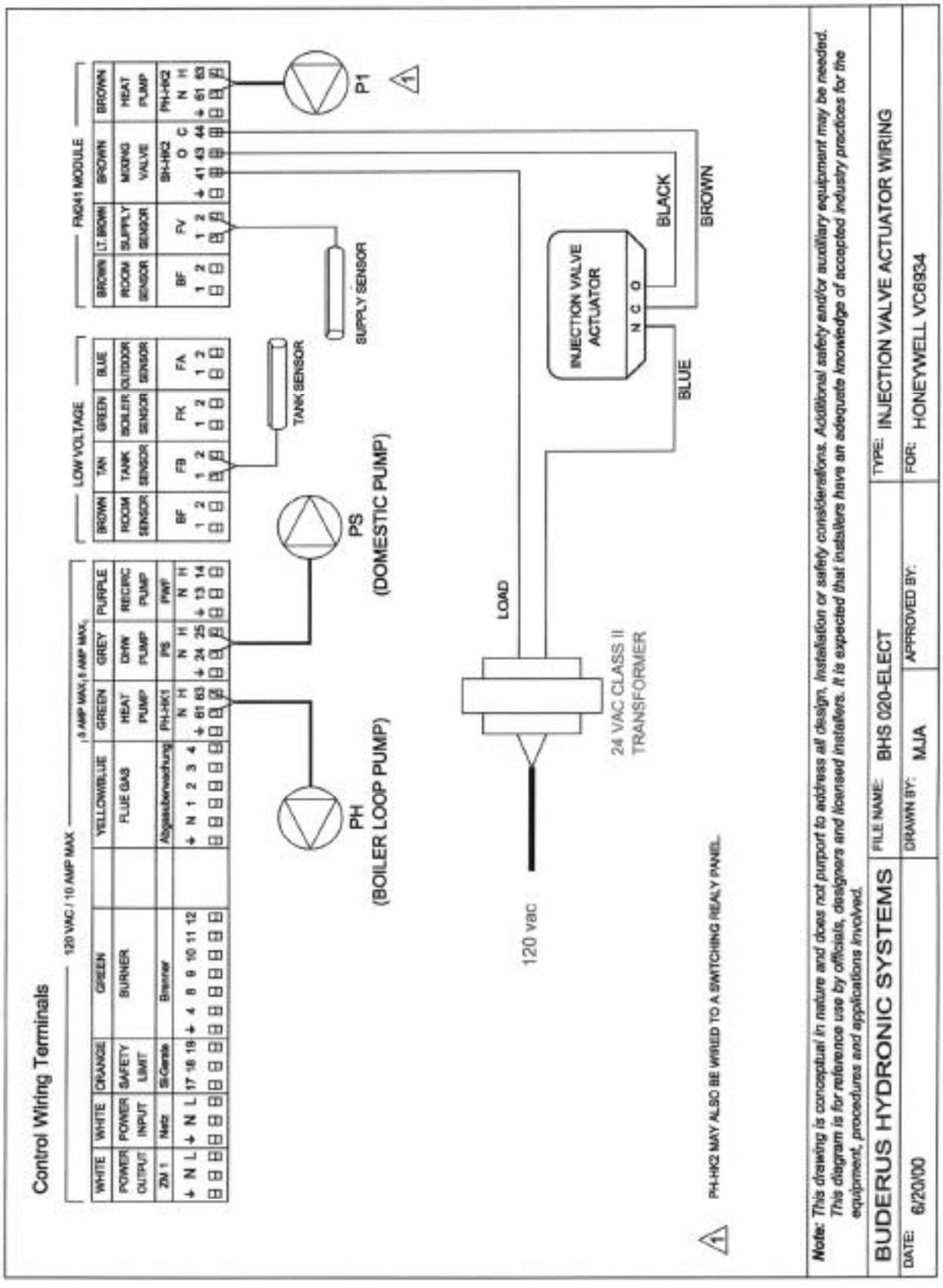
Buderus Hydronic Systems | CONCEPT ELECTRICAL DIAGRAM | DRAWING# ECO-019-ELECT | DATE: 7/4/00 | DRAWN BY: MJA | REV: 01

4 Application Drawings

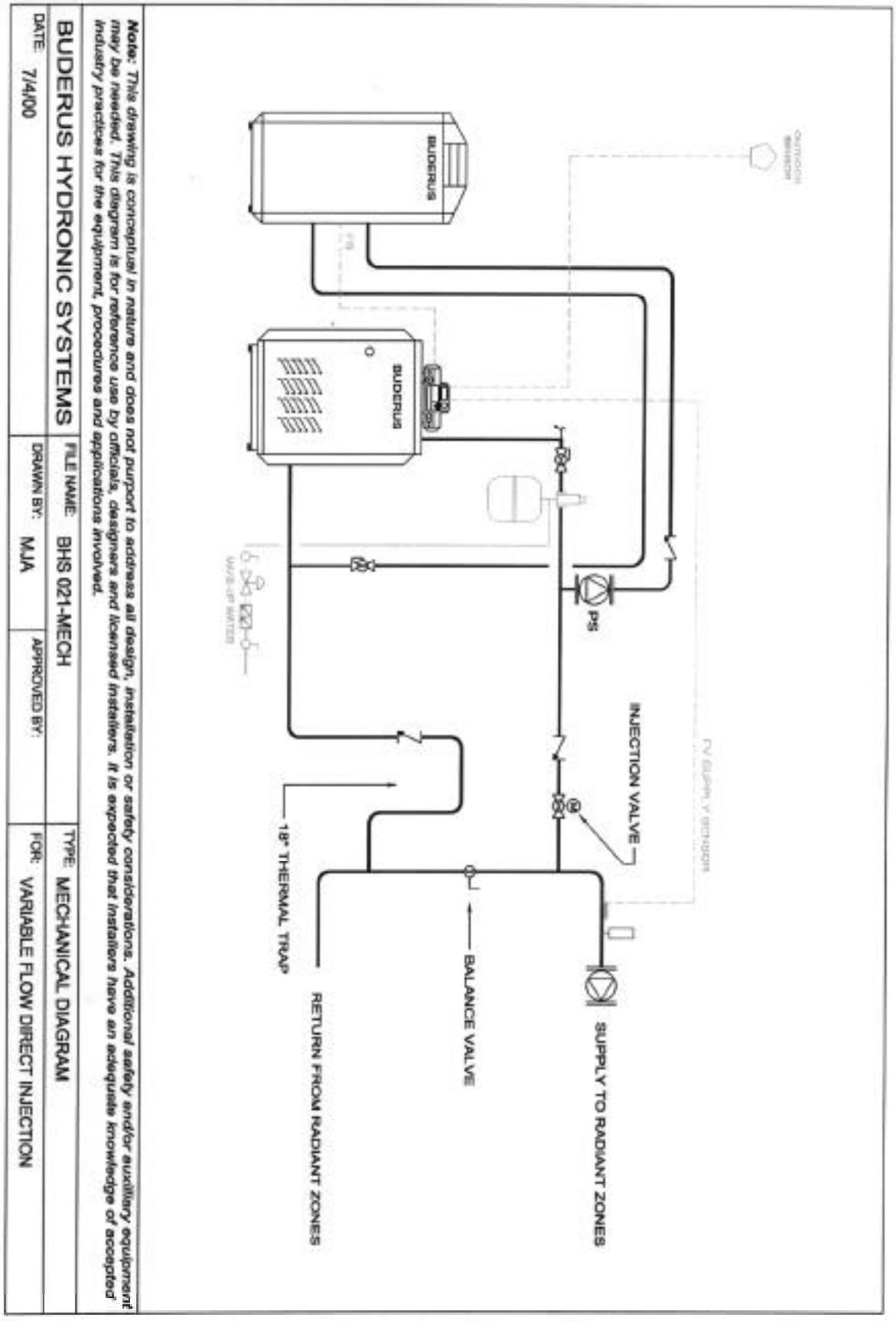


Note: This drawing is conceptual in nature and does not purport to address all design, installation or safety considerations. Additional safety and/or auxiliary equipment may be needed. This diagram is for reference use by officials, designers and licensed installers. It is expected that installers have an adequate knowledge of accepted industry practices for the equipment, procedures and applications involved.

BUDERUS HYDRONIC SYSTEMS	FILE NAME: BHS 020-MECH	TYPE: MECHANICAL DIAGRAM
DATE: 6/20/00	DRAWN BY: MJA	APPROVED BY:
		FOR: PRIMARY / SECONDARY VARIABLE FLOW INJECTION

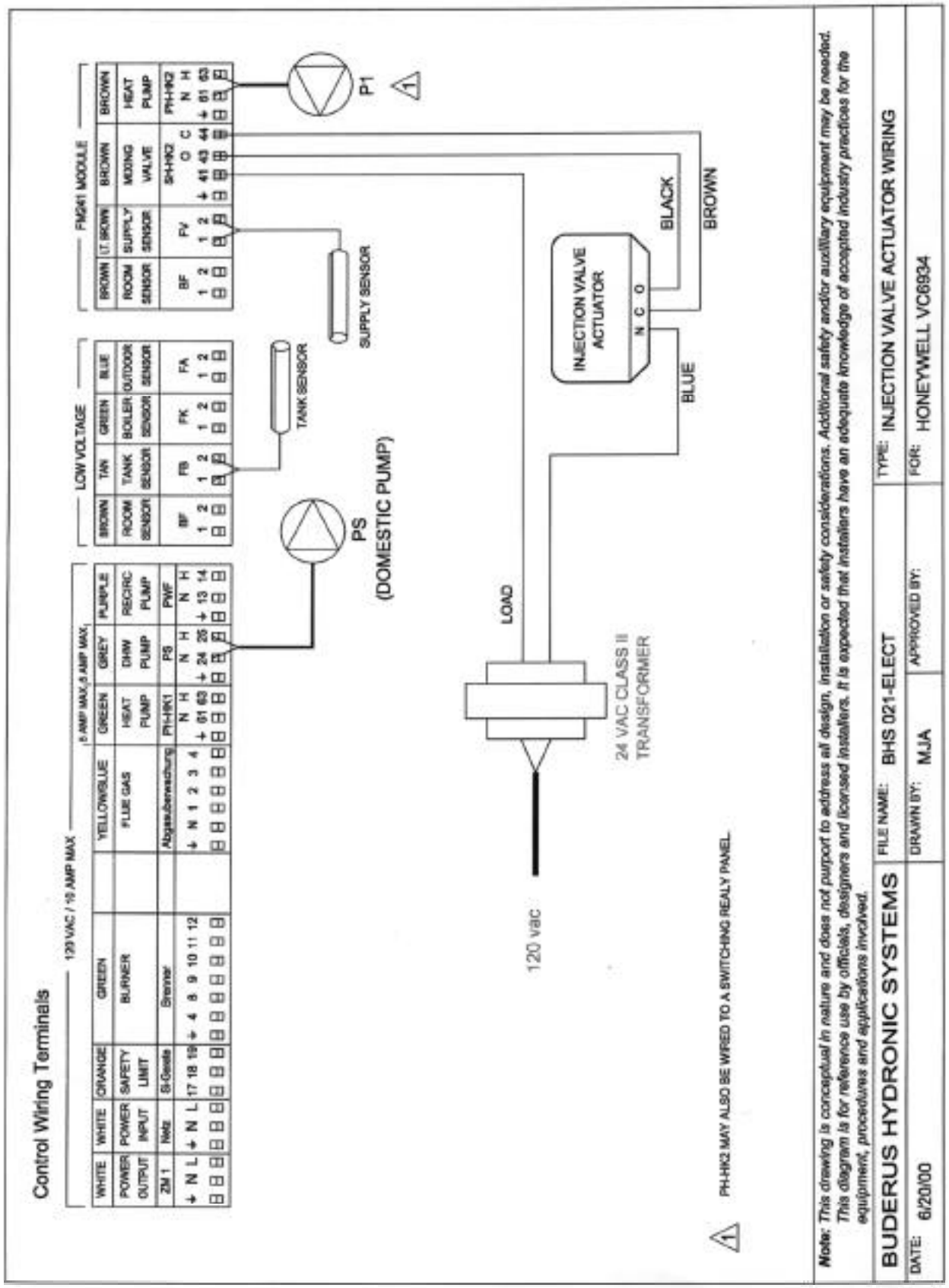

Control Wiring Terminals
120 VAC / 10 AMP MAX
5 AMP MAX, 5 AMP MAX
LOW VOLTAGE
RN841 MODULE
PH
(BOILER LOOP PUMP)
PS
(DOMESTIC PUMP)
P1
TANK SENSOR
SUPPLY SENSOR
LOAD
120 vac
24 VAC CLASS II
TRANSFORMER
INJECTION VALVE
ACTUATOR
BLACK
BLUE
BROWN
PH-HK2 MAY ALSO BE WIRED TO A SWITCHING REALY PANEL.
Note: This drawing is conceptual in nature and does not purport to address all design, installation or safety considerations. Additional safety and/or auxiliary equipment may be needed. This diagram is for reference use by officials, designers and licensed installers. It is expected that installers have an adequate knowledge of accepted industry practices for the equipment, procedures and applications involved.
BUDERUS HYDRONIC SYSTEMS
FILE NAME: BHS 020-ELECT
TYPE: INJECTION VALVE ACTUATOR WIRING
DATE: 6/20/00
DRAWN BY: MJA
APPROVED BY:
FOR: HONEYWELL VC6934

4 Application Drawings



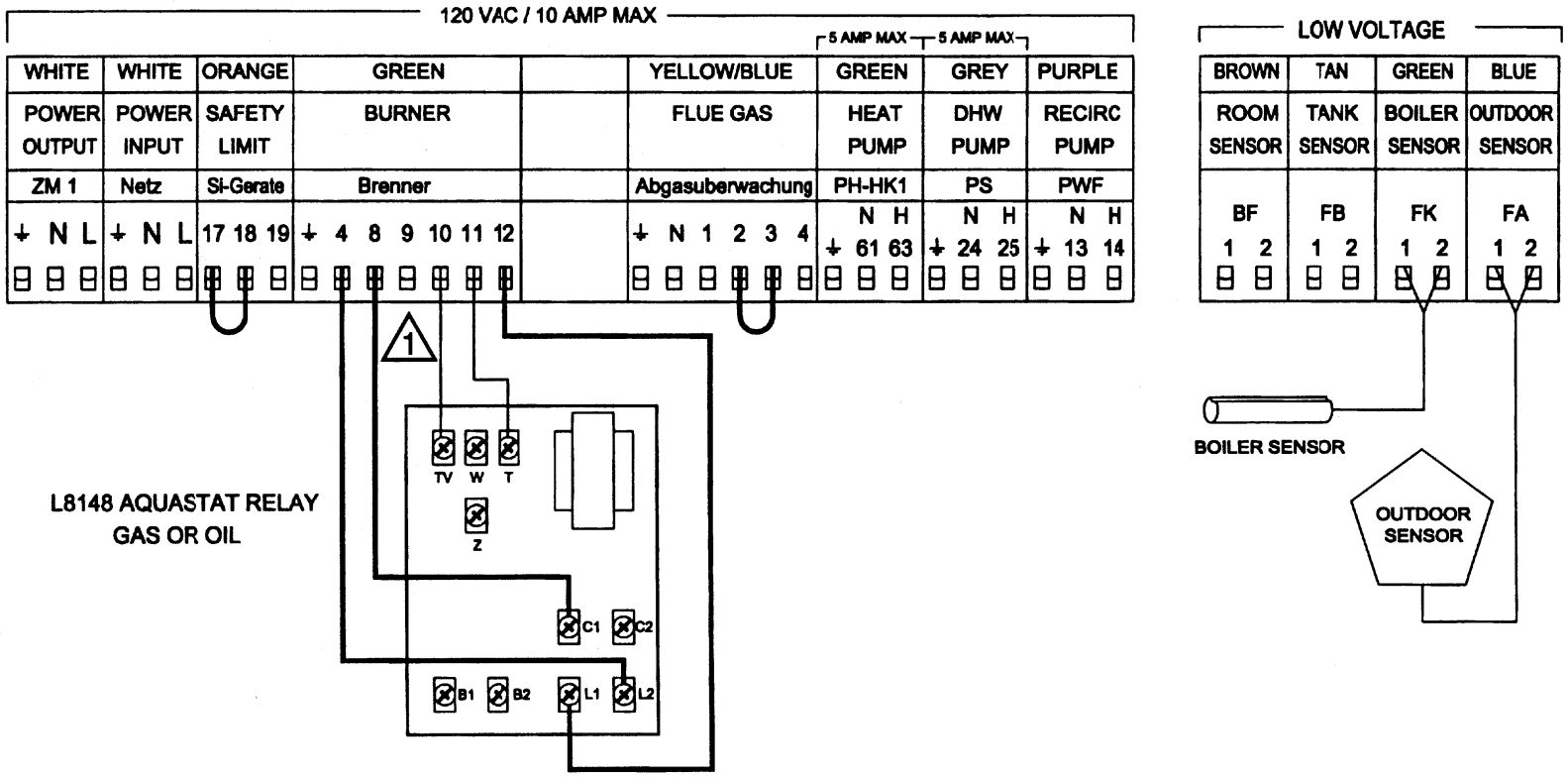
Note: *This drawing is conceptual in nature and does not purport to address all design, installation or safety considerations. Additional safety and/or auxiliary equipment may be needed. This diagram is for reference use by officials, designers and licensed installers. It is expected that installers have an adequate knowledge of accepted industry practices for the equipment, procedures and applications involved.*

BUDERUS HYDRONIC SYSTEMS	FILE NAME: BHS 021-MECH	TYPE: MECHANICAL DIAGRAM
DATE: 7/4/00	DRAWN BY: MJA	APPROVED BY:	FOR: VARIABLE FLOW DIRECT INJECTION


Control Wiring Terminals
120 VAC / 10 AMP MAX
8 AMP MAX, 8 AMP MAX
LOW VOLTAGE
FM241 MODULE
WHITE
POWER OUTPUT
ZM 1
WHITE
POWER INPUT
NHz
ORANGE
SAFETY LIMIT
SI-Geste
GREEN
BURNER
Brenner
YELLOW/BLUE
FLUE GAS
Abgasüberwachung
GREEN
HEAT PUMP
PH-HK1
GREY
DHW PUMP
PS
PURPLE
RECIRC PUMP
PWF
BROWN
ROOM SENSOR
BF
TAN
TANK SENSOR
FB
GREEN
BOILER SENSOR
FK
BLUE
OUTDOOR SENSOR
FA
LT. BROWN
SUPPLY SENSOR
FV
BROWN
MIXING VALVE
SHHK2
BROWN
HEAT PUMP
PH-HK2
P1
PS
(DOMESTIC PUMP)
TANK SENSOR
SUPPLY SENSOR
LOAD
120 vac
24 VAC CLASS II
TRANSFORMER
INJECTION VALVE
ACTUATOR
N C O
BLACK
BLUE
BROWN
PH-HK2 MAY ALSO BE WIRED TO A SWITCHING REALY PANEL
Note: This drawing is conceptual in nature and does not purport to address all design, installation or safety considerations. Additional safety and/or auxiliary equipment may be needed. This diagram is for reference use by officials, designers and licensed installers. It is expected that installers have an adequate knowledge of accepted industry practices for the equipment, procedures and applications involved.
BUDERUS HYDRONIC SYSTEMS
FILE NAME: BHS 021-ELECT
TYPE: INJECTION VALVE ACTUATOR WIRING
DATE: 6/20/00
DRAWN BY: MJA
APPROVED BY:
FOR: HONEYWELL VC6934

5 Burner/Boiler Wiring

Control Wiring Terminals



120V AC ——————

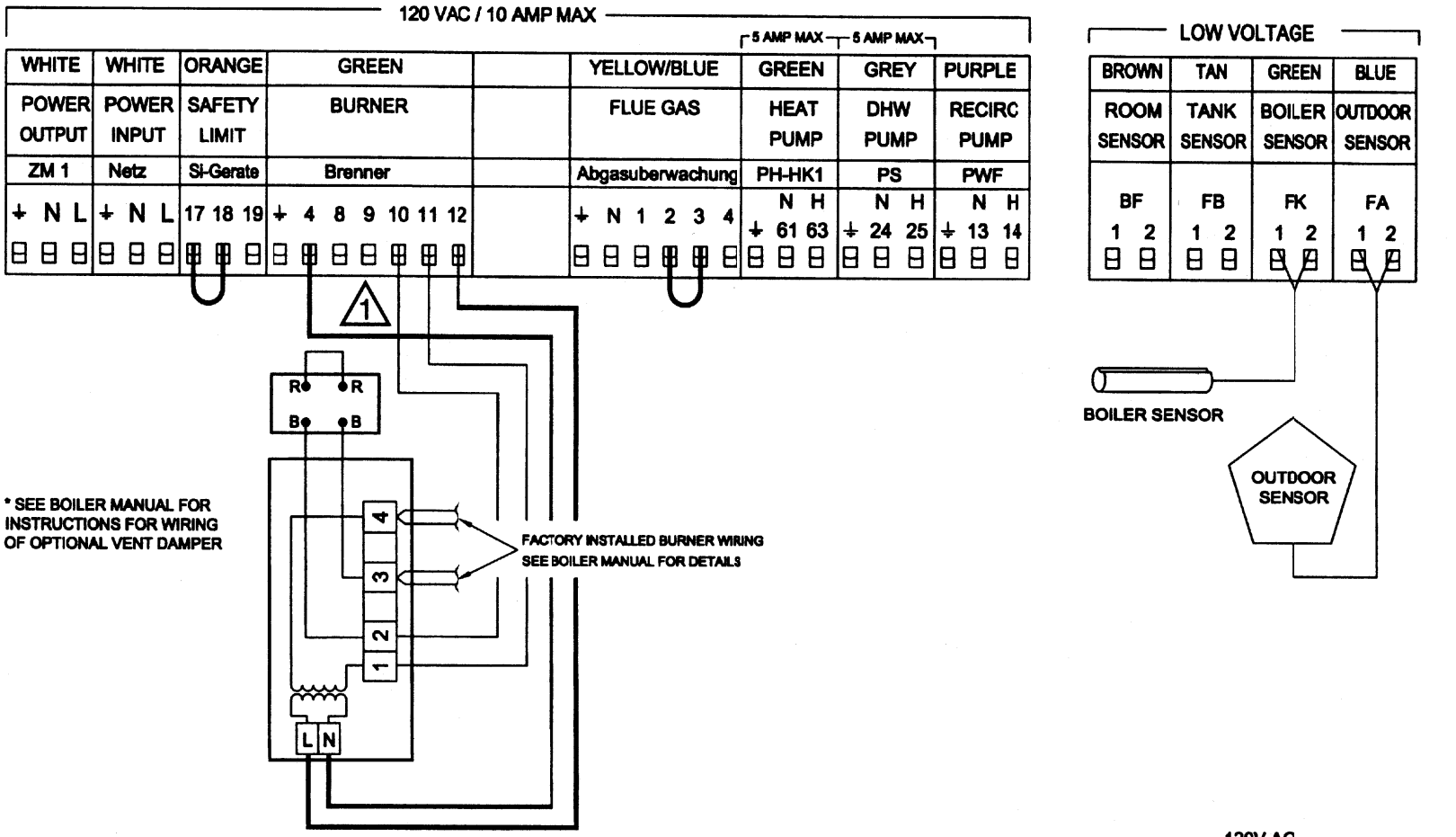
24V #18 WIRE ——————

1 Remove factory installed jumper between terminals 10 and 12.

***Note:** This drawing is conceptual in nature and does not purport to address all design, installation or safety considerations. Additional safety and/or auxilliary equipment may be needed. This diagram is for reference use by officials, designers and licensed installers. It is expected that installers have an adequate knowledge of accepted industry practices for the equipment, procedures and applications involved.*

BUDERUS HYDRONIC SYSTEMS	FILE NAME: BHS WDECO.1		TYPE: BURNER WIRING DIAGRAM
DATE: 2/20/00	DRAWN BY: MJA	APPROVED BY:	FOR: L8148 AQUASTAT RELAY

Control Wiring Terminals

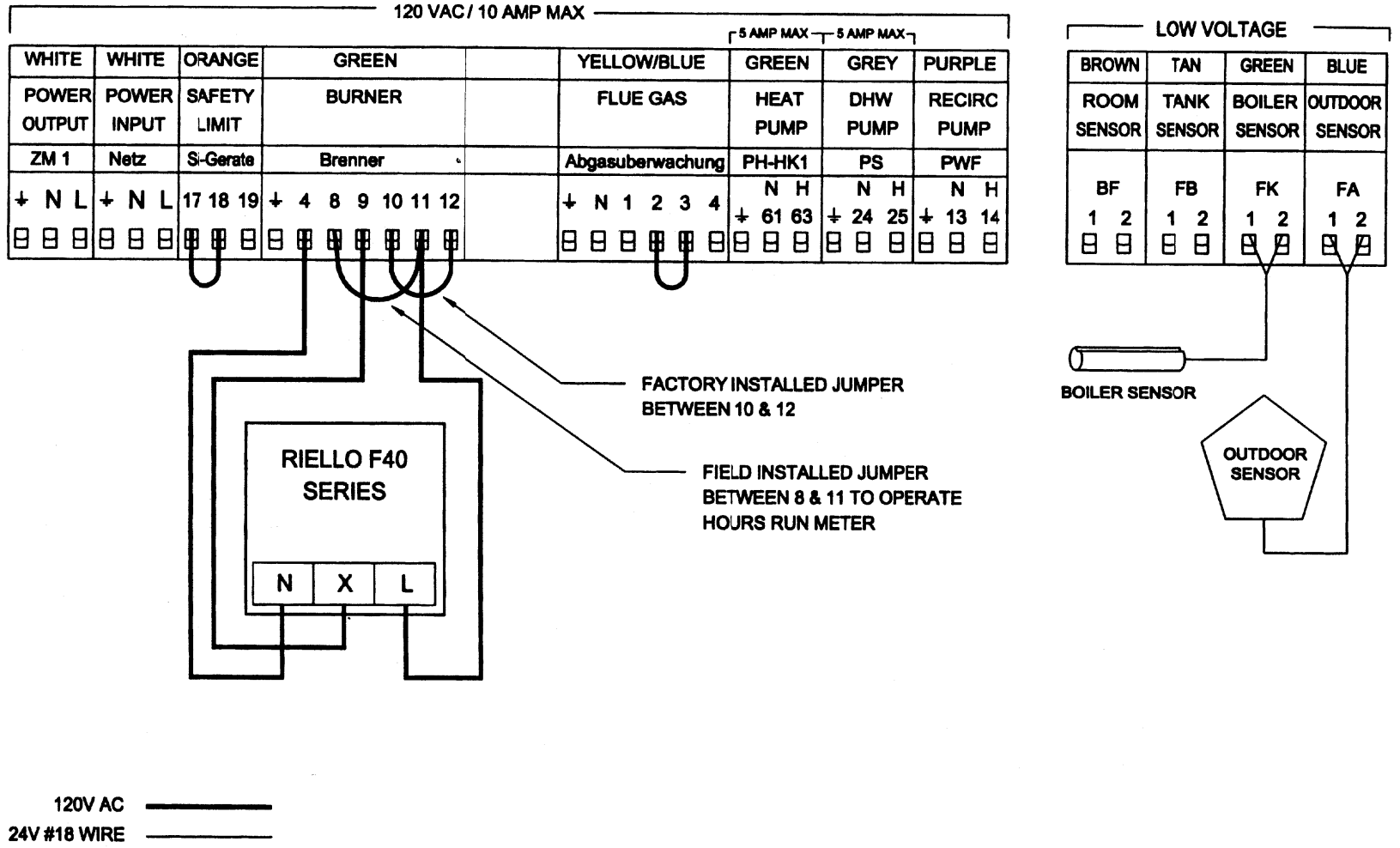


1 Remove factory installed jumper between terminals 10 and 12.

***Note:** This drawing is conceptual in nature and does not purport to address all design, installation or safety considerations. Additional safety and/or auxilliary equipment may be needed. This diagram is for reference use by officials, designers and licensed installers. It is expected that installers have an adequate knowledge of accepted industry practices for the equipment, procedures and applications involved.*

BUDERUS HYDRONIC SYSTEMS	FILE NAME: BHS WDECO.2		TYPE: BURNER WIRING DIAGRAM
DATE: 2/20/00	DRAWN BY: MJA	APPROVED BY:	FOR: G334X , G224E/73-128, GAS BOILERS - 1 STAGE

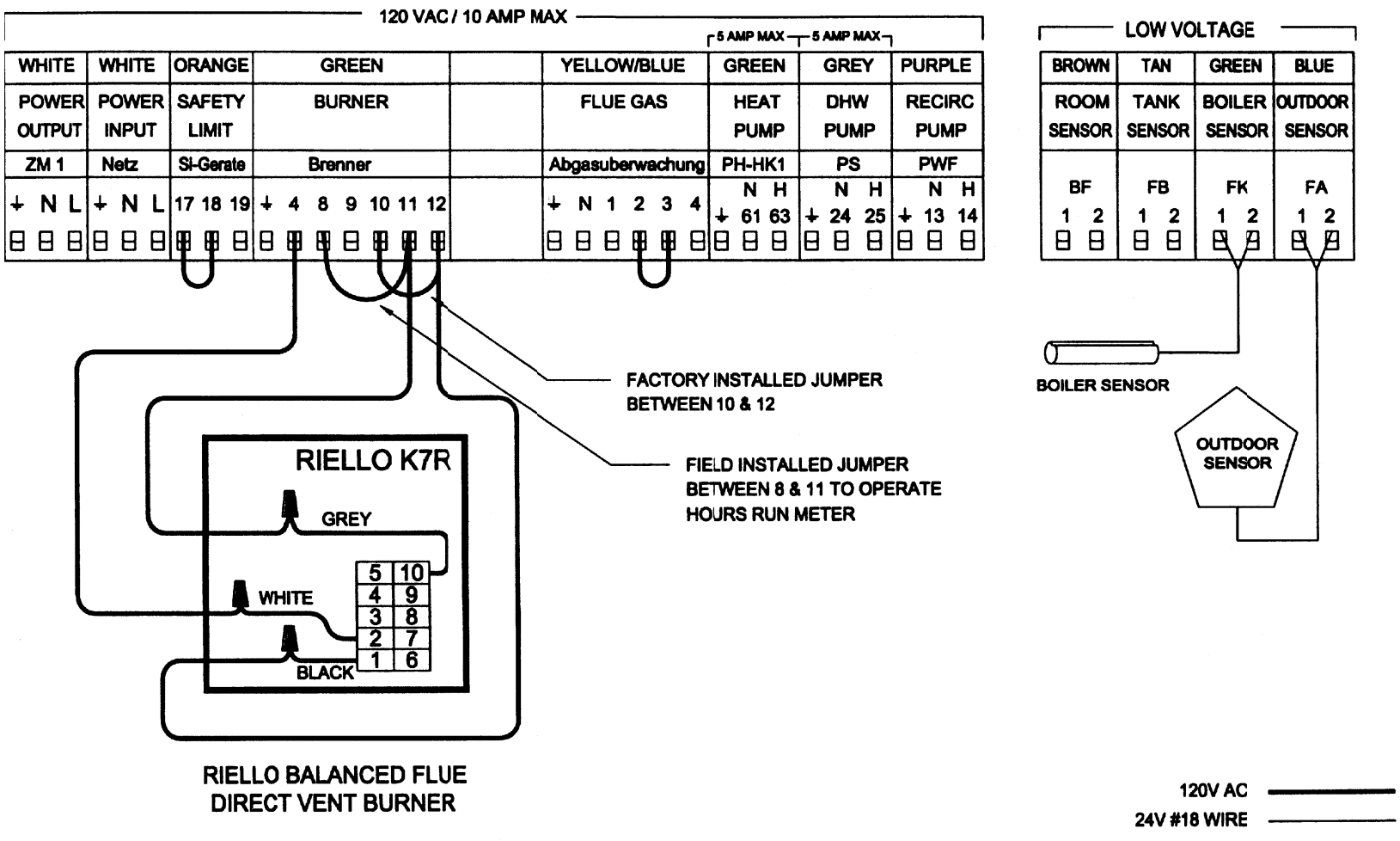
Control Wiring Terminals



***Note:** This drawing is conceptual in nature and does not purport to address all design, installation or safety considerations. Additional safety and/or auxiliary equipment may be needed. This diagram is for reference use by officials, designers and licensed installers. It is expected that installers have an adequate knowledge of accepted industry practices for the equipment, procedures and applications involved.*

BUDERUS HYDRONIC SYSTEMS	FILE NAME: BHS WDECO.4		TYPE: BURNER WIRING DIAGRAM
DATE: 2/20/00	DRAWN BY: MJA	APPROVED BY:	FOR: RIELLO F40 SERIES F3, F5, F10

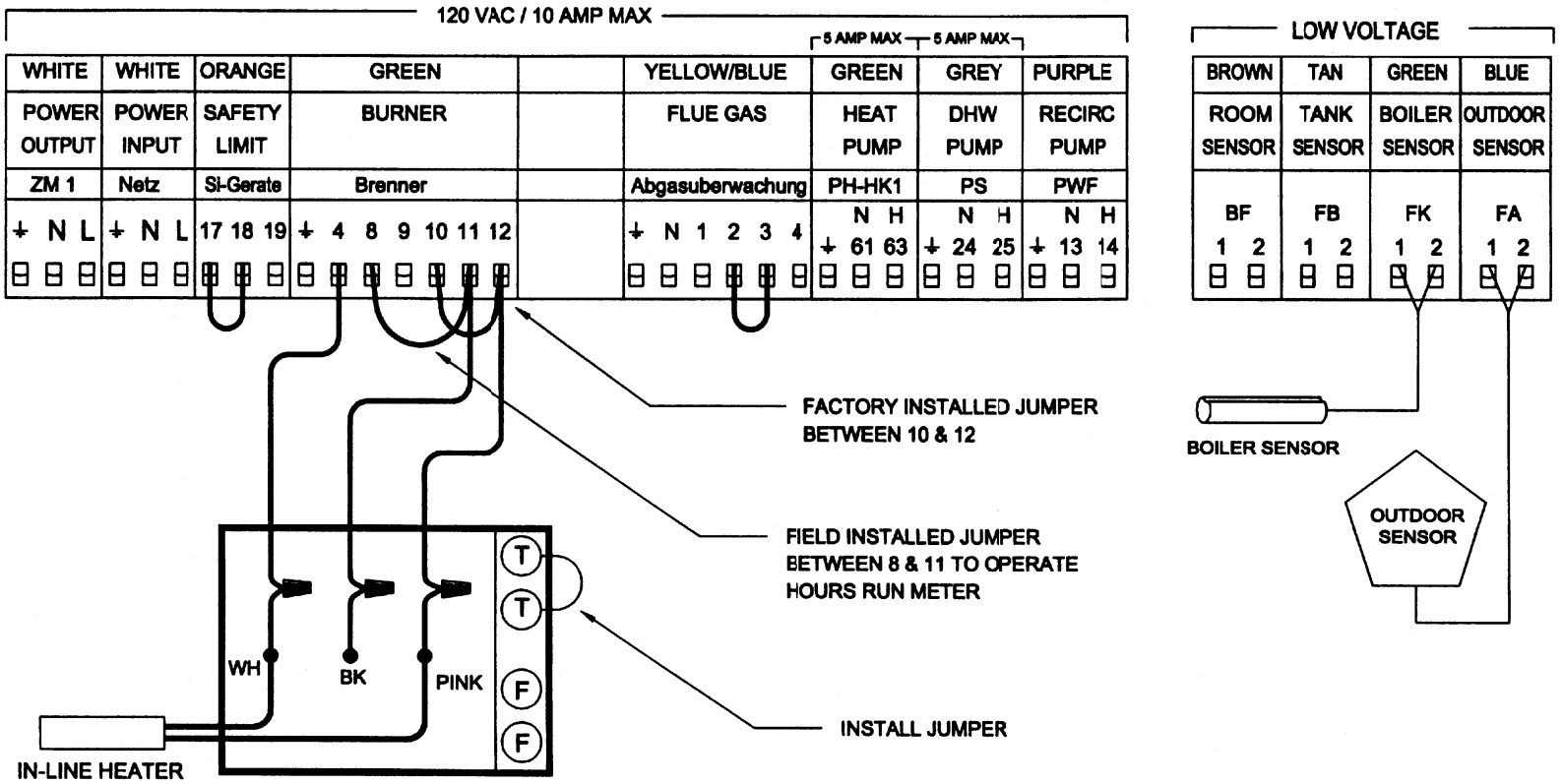
Control Wiring Terminals



***Note:** This drawing is conceptual in nature and does not purport to address all design, installation or safety considerations. Additional safety and/or auxilliary equipment may be needed. This diagram is for reference use by officials, designers and licensed installers. It is expected that installers have an adequate knowledge of accepted industry practices for the equipment, procedures and applications involved.*

BUDERUS HYDRONIC SYSTEMS	FILE NAME: BHS WDECO.9		TYPE: BURNER WIRING DIAGRAM
DATE: 3/21/00	DRAWN BY: MJA	APPROVED BY:	FOR: RIELLO BF40 SERIES WITH K7R CONTROL

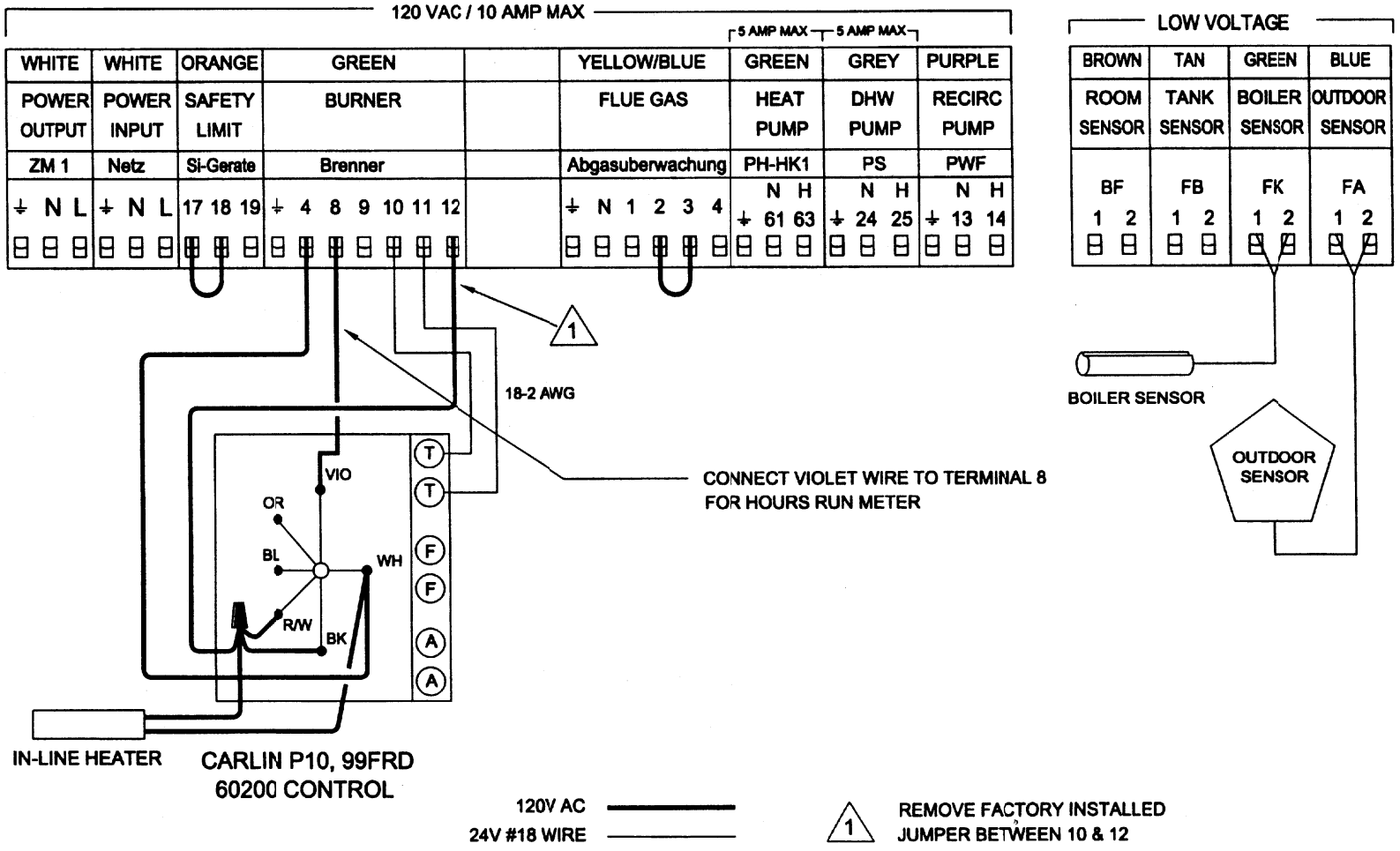
Control Wiring Terminals



***Note:** This drawing is conceptual in nature and does not purport to address all design, installation or safety considerations. Additional safety and/or auxiliary equipment may be needed. This diagram is for reference use by officials, designers and licensed installers. It is expected that installers have an adequate knowledge of accepted industry practices for the equipment, procedures and applications involved.*

BUDERUS HYDRONIC SYSTEMS	FILE NAME: BHS WDECO.5		TYPE: BURNER WIRING DIAGRAM
DATE: 2/23/00	DRAWN BY: MJA	APPROVED BY:	FOR: CARLIN EZ1 WITH 40200-02 CONTROL

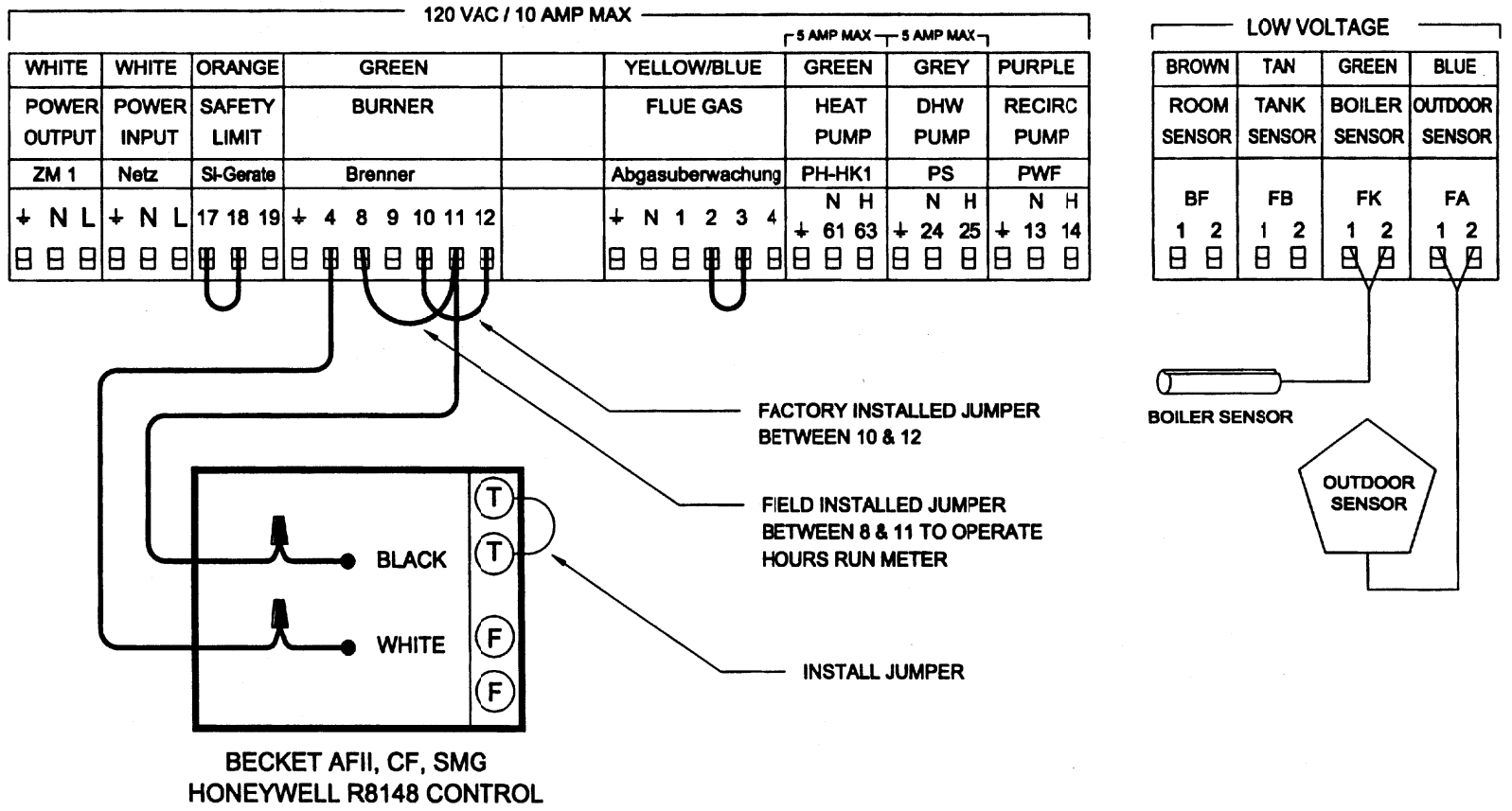
Control Wiring Terminals



***Note:** This drawing is conceptual in nature and does not purport to address all design, installation or safety considerations. Additional safety and/or auxilliary equipment may be needed. This diagram is for reference use by officials, designers and licensed installers. It is expected that installers have an adequate knowledge of accepted industry practices for the equipment, procedures and applications involved.*

BUDERUS HYDRONIC SYSTEMS	FILE NAME: BHS WDECO.6		TYPE: BURNER WIRING DIAGRAM
DATE: 11/27/00	DRAWN BY: MJA	APPROVED BY: EL	FOR: CARLIN P10, 99 FRD - 60200-02 CONTROL

Control Wiring Terminals



***Note:** This drawing is conceptual in nature and does not purport to address all design, installation or safety considerations. Additional safety and/or auxiliary equipment may be needed. This diagram is for reference use by officials, designers and licensed installers. It is expected that installers have an adequate knowledge of accepted industry practices for the equipment, procedures and applications involved.*

BUDERUS HYDRONIC SYSTEMS	FILE NAME: BHS WDECO.8		TYPE: BURNER WIRING DIAGRAM
DATE: 2/23/00	DRAWN BY: MJA	APPROVED BY:	FOR: BECKETT AFII, CF, SMG - R8148 CONTROL

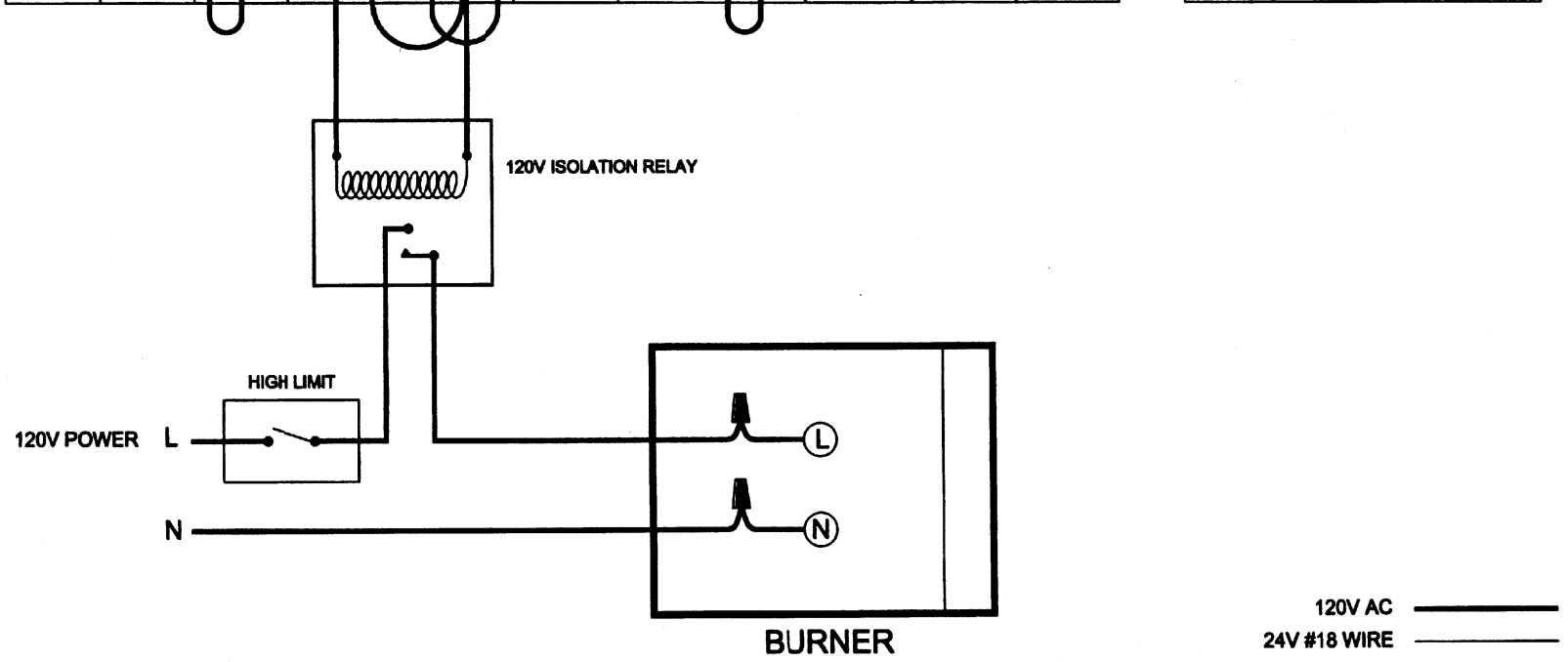
Control Wiring Terminals

120 VAC / 10 AMP MAX — 5 AMP MAX — 5 AMP MAX

WHITE	WHITE	ORANGE	GREEN		YELLOW/BLUE	GREEN	GREY	PURPLE
POWER OUTPUT	POWER INPUT	SAFETY LIMIT	BURNER		FLUE GAS	HEAT PUMP	DHW PUMP	RECIRC PUMP
ZM 1	Netz	Si-Gerate	Brenner		Abgasuberwachung	PH-HK1	PS	PWF
⏚ N L	⏚ N L	17 18 19	⏚ 4 8 9 10 11 12		⏚ N 1 2 3 4	N H ⏚ 61 63	N H ⏚ 24 25	N H ⏚ 13 14

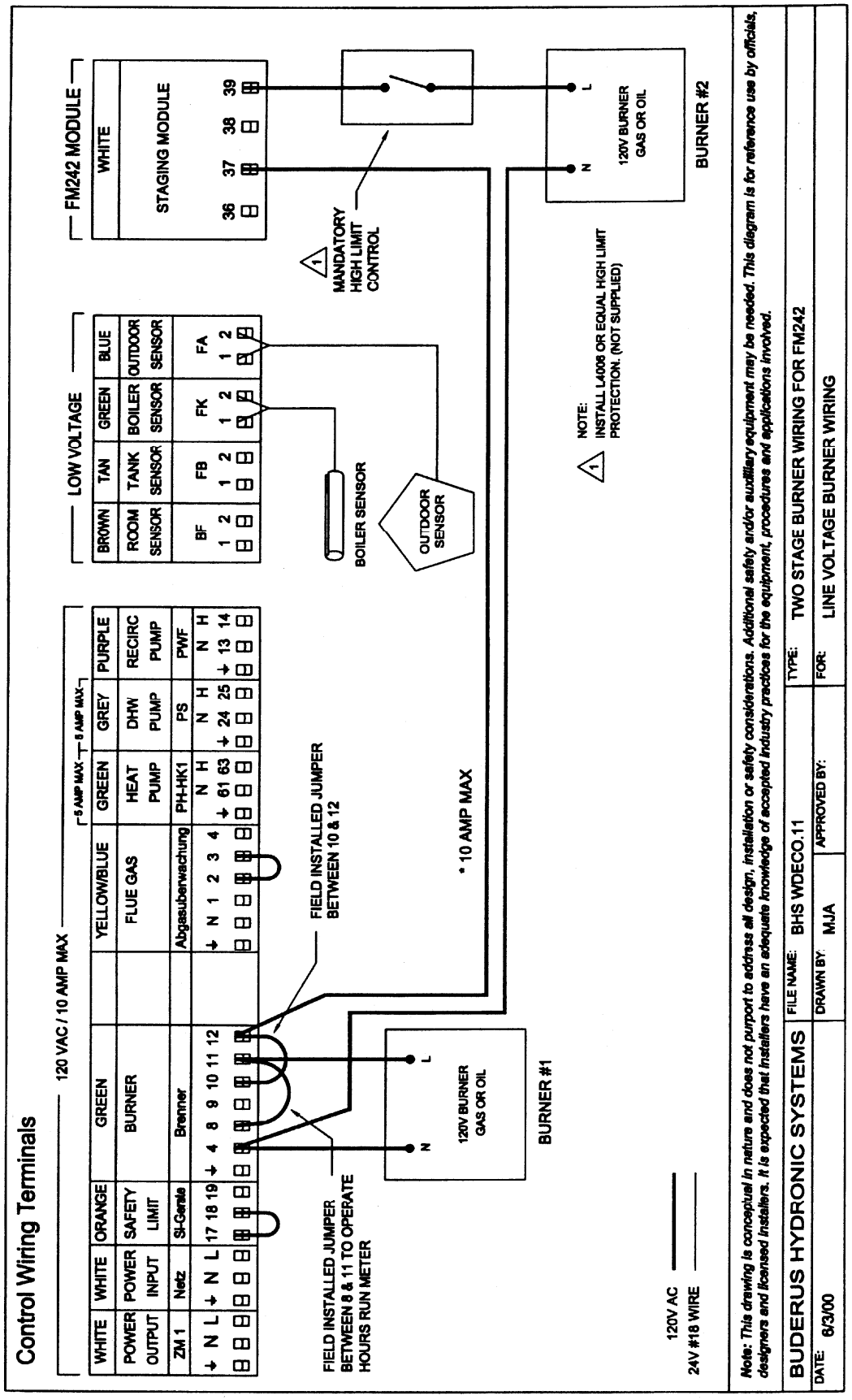
LOW VOLTAGE

BROWN	TAN	GREEN	BLUE
ROOM SENSOR	TANK SENSOR	BOILER SENSOR	OUTDOOR SENSOR
BF	FB	FK	FA
1 2	1 2	1 2	1 2

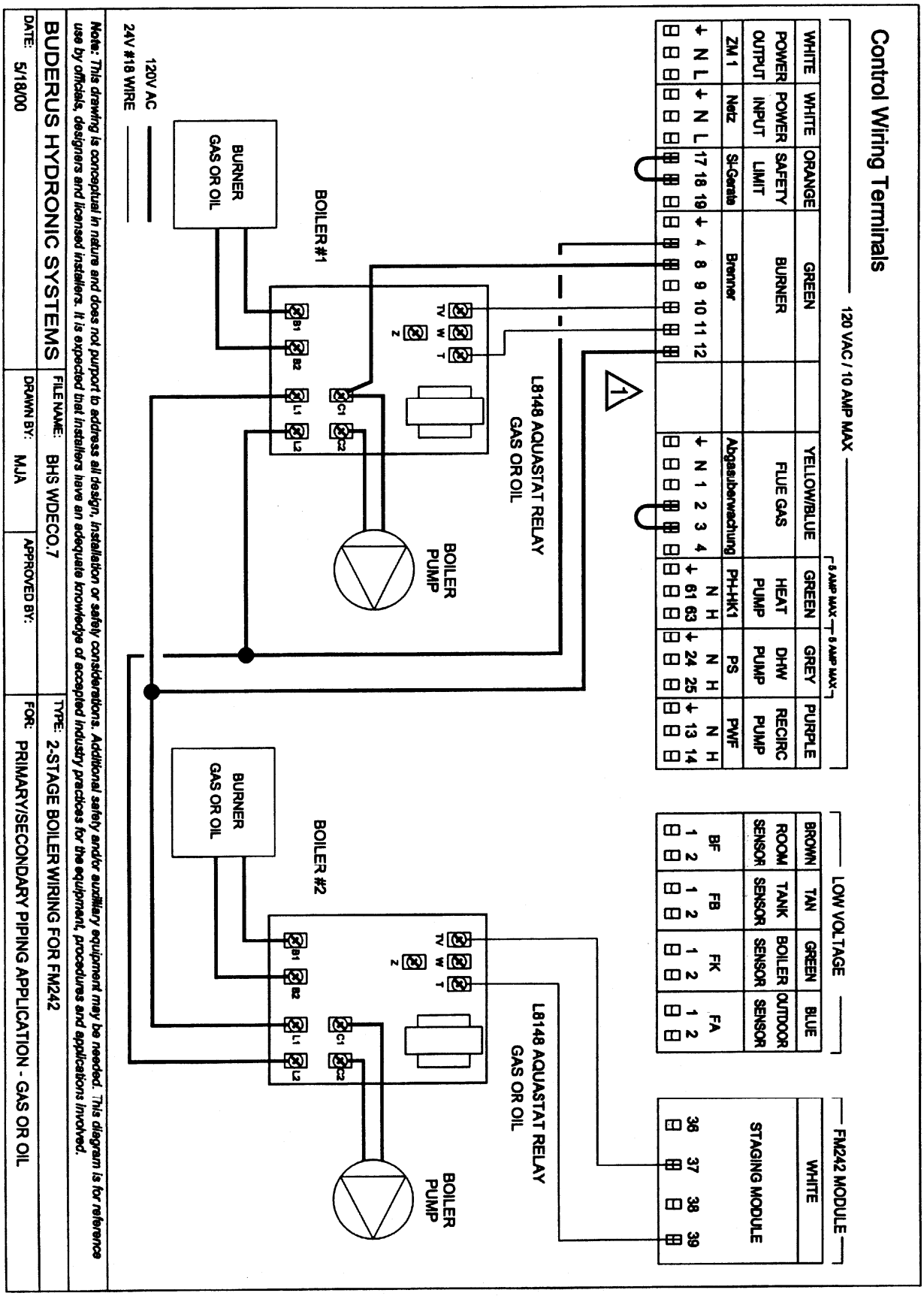


***Note:** This drawing is conceptual in nature and does not purport to address all design, installation or safety considerations. Additional safety and/or auxilliary equipment may be needed. This diagram is for reference use by officials, designers and licensed installers. It is expected that installers have an adequate knowledge of accepted industry practices for the equipment, procedures and applications involved.*

BUDERUS HYDRONIC SYSTEMS	FILE NAME: BHS WDECO.10		TYPE: BURNER WIRING DIAGRAM
DATE: 3/22/00	DRAWN BY: MJA	APPROVED BY:	FOR: ISOLATION RELAY FOR HIGH AMP BURNER

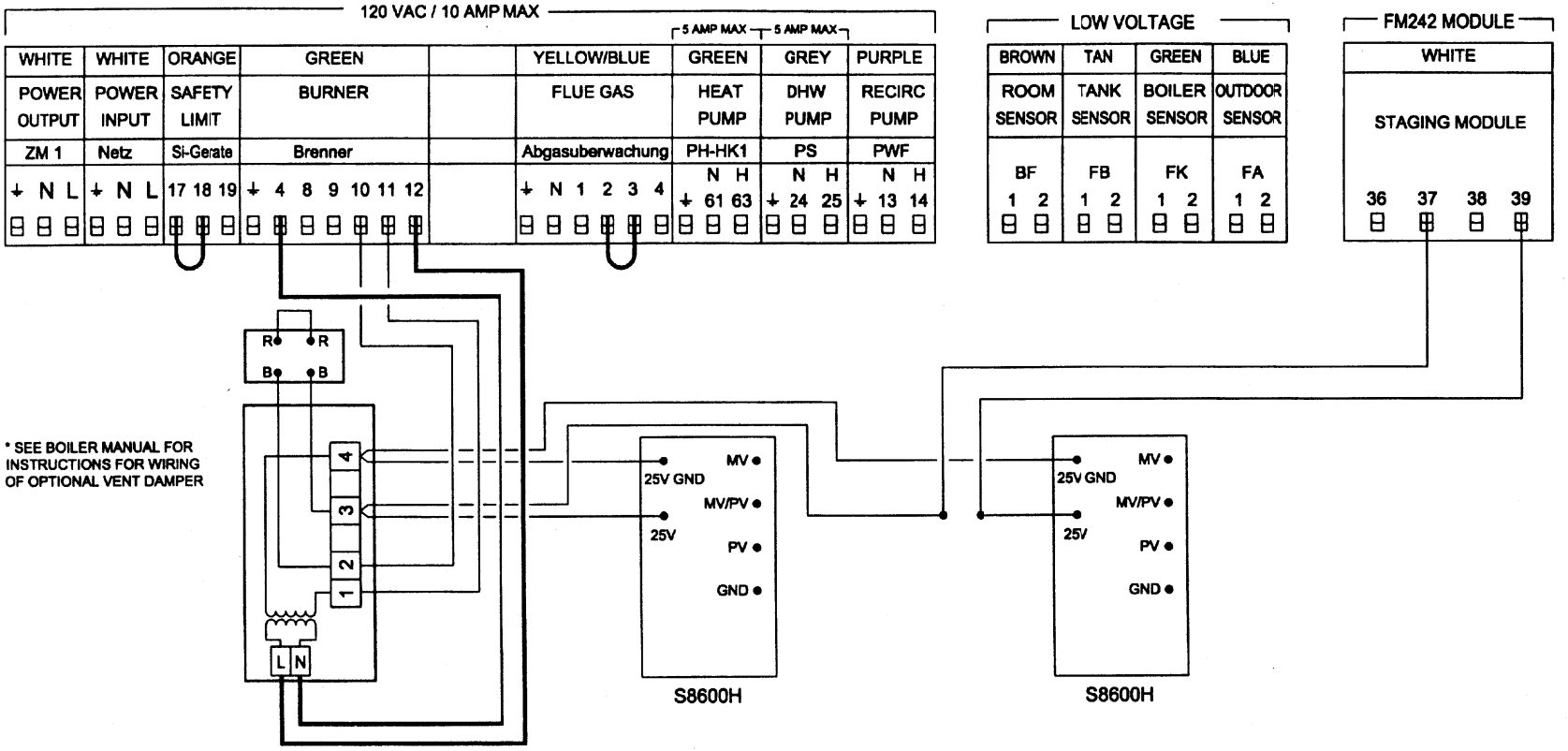

Control Wiring Terminals
120 VAC / 10 AMP MAX
5 AMP MAX
5 AMP MAX
WHITE
POWER OUTPUT
WHITE
POWER INPUT
ORANGE
SAFETY LIMIT
GREEN
BURNER
YELLOW/BLUE
FLUE GAS
GREEN
HEAT PUMP
GREY
DHW PUMP
PURPLE
RECIRC PUMP
ZM 1
Netz
SI-Geräte
Brenner
Abgasüberwachung
PH-HK1
PS
PWF
LOW VOLTAGE
BROWN
ROOM SENSOR
TAN
TANK SENSOR
GREEN
BOILER SENSOR
BLUE
OUTDOOR SENSOR
BF
FB
FK
FA
FM242 MODULE
WHITE
STAGING MODULE
36 37 38 39
FIELD INSTALLED JUMPER BETWEEN 9 & 11 TO OPERATE HOURS RUN METER
FIELD INSTALLED JUMPER BETWEEN 10 & 12
* 10 AMP MAX
120V BURNER GAS OR OIL
BURNER #1
BOILER SENSOR
OUTDOOR SENSOR
MANDATORY HIGH LIMIT CONTROL
NOTE: INSTALL L4006 OR EQUAL HIGH LIMIT PROTECTION. (NOT SUPPLIED)
120V BURNER GAS OR OIL
BURNER #2
120V AC
24V #18 WIRE
Note: This drawing is conceptual in nature and does not purport to address all design, installation or safety considerations. Additional safety and/or auxiliary equipment may be needed. This diagram is for reference use by officials, designers and licensed installers. It is expected that installers have an adequate knowledge of accepted industry practices for the equipment, procedures and applications involved.
BUDERUS HYDRONIC SYSTEMS
FILE NAME: BHS WDECO.11
TYPE: TWO STAGE BURNER WIRING FOR FM242
DATE: 6/3/00
DRAWN BY: MJA
APPROVED BY:
FOR: LINE VOLTAGE BURNER WIRING

5 Burner/Boiler Wiring



1 Remove factory installed jumper between terminals 10 and 12.

Control Wiring Terminals



Note: This drawing is conceptual in nature and does not purport to address all design, installation or safety considerations. Additional safety and/or auxilliary equipment may be needed. This diagram is for reference use by officials, designers and licensed installers. It is expected that installers have an adequate knowledge of accepted industry practices for the equipment, procedures and applications involved.

BUDERUS HYDRONIC SYSTEMS	FILE NAME: BHS WDECO.3		TYPE: BURNER WIRING DIAGRAM
DATE: 2/20/00	DRAWN BY: MJA	APPROVED BY:	FOR: G334X , G224E/73-128, GAS BOILERS - 2 STAGE

6 Multi-Zone Relay Controls

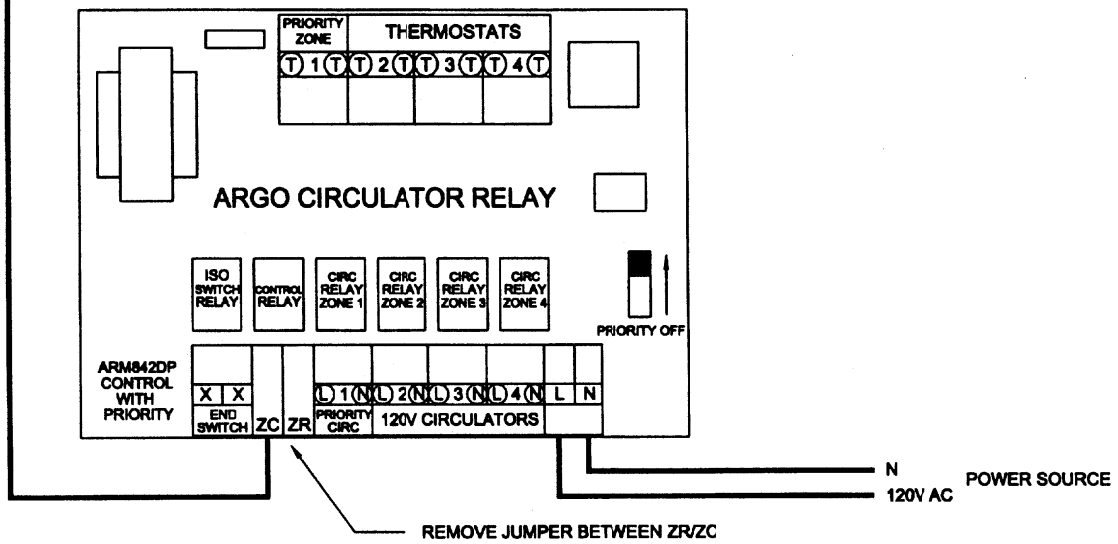
Control Wiring Terminals

120 VAC / 10 AMP MAX — 5 AMP MAX — 5 AMP MAX

WHITE	WHITE	ORANGE	GREEN		YELLOW/BLUE	GREEN	GREY	PURPLE
POWER OUTPUT	POWER INPUT	SAFETY LIMIT	BURNER		FLUE GAS	HEAT PUMP	DHW PUMP	RECIRC PUMP
ZM 1	Netz	Si-Gerate	Brenner		Abgasuberwachung	PH-HK1	PS	PWF
⏚ N L	⏚ N L	17 18 19	⏚ 4 8 9 10 11 12		⏚ N 1 2 3 4	N H ⏚ 61 63	N H ⏚ 24 25	N H ⏚ 13 14

LOW VOLTAGE

BROWN	TAN	GREEN	BLUE
ROOM SENSOR	TANK SENSOR	BOILER SENSOR	OUTDOOR SENSOR
BF	FB	FK	FA
1 2	1 2	1 2	1 2



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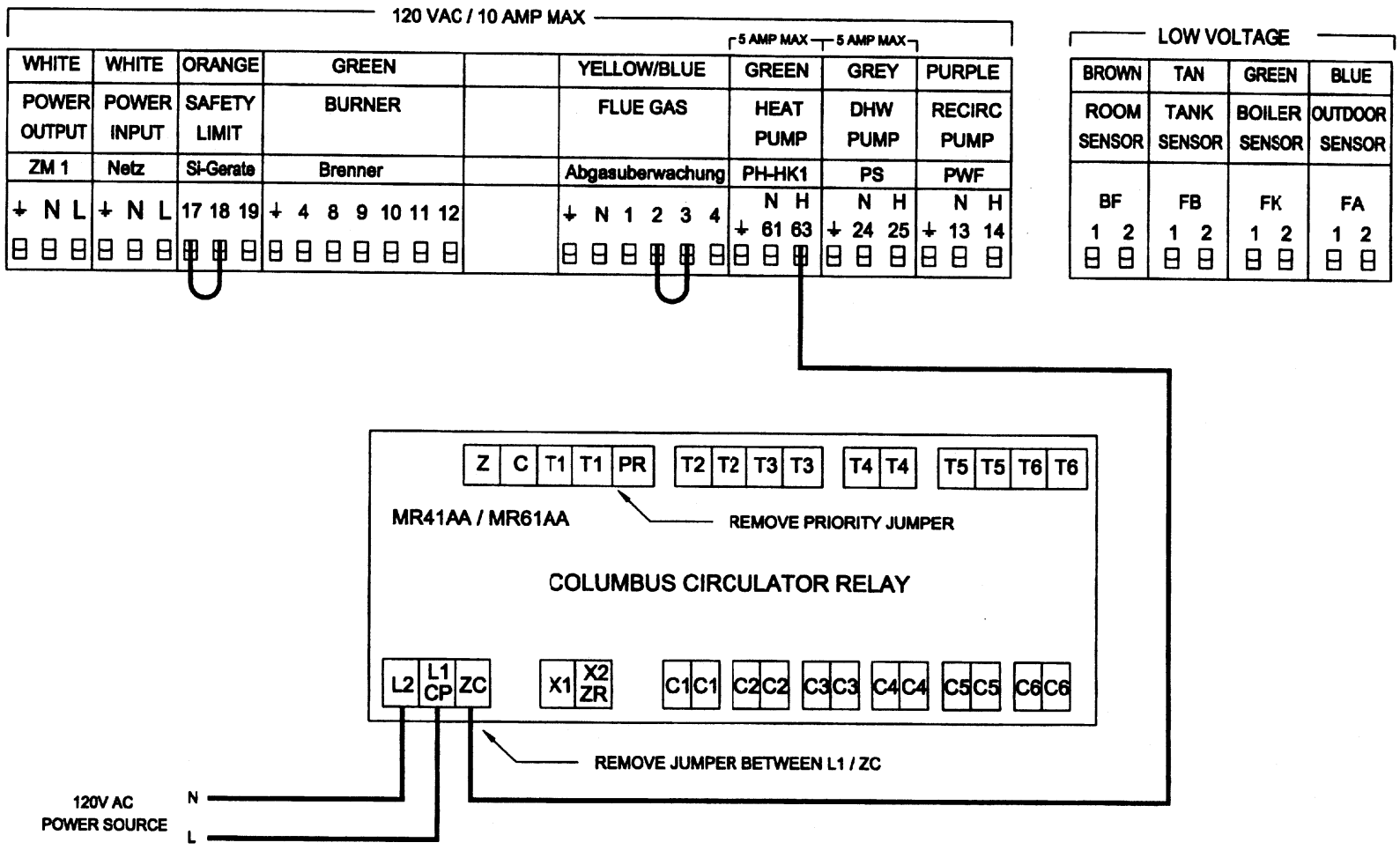
BUDERUS HYDRONIC SYSTEMS	FILE NAME: BHS WDECO.ARM842		TYPE: MULTI-ZONE RELAY CONTROL
DATE: 2/22/00	DRAWN BY: MJA	APPROVED BY:	FOR: ARGO MODELS ARM861DP, ARM842DP, ARM866DP

Control Wiring Terminals



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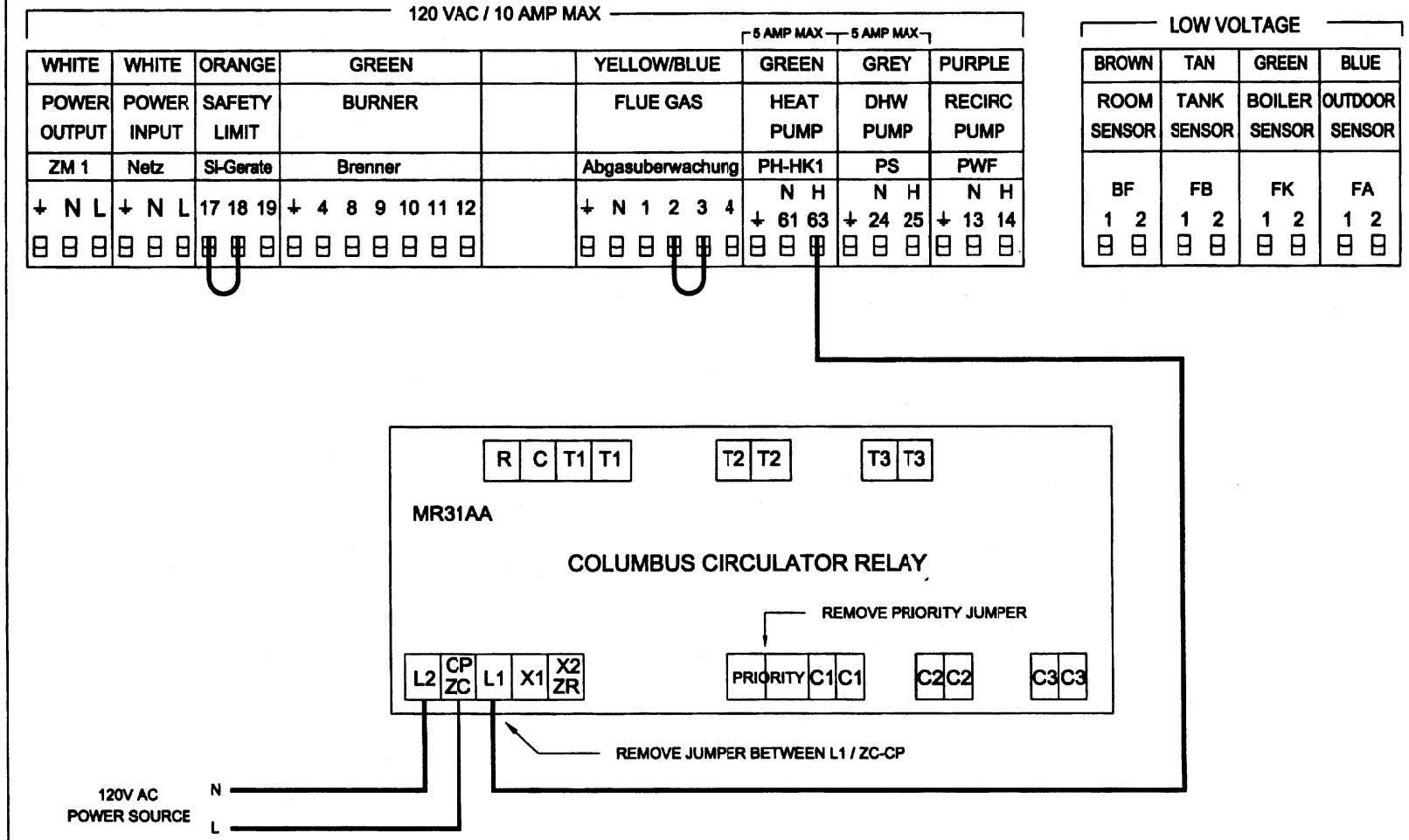
BUDERUS HYDRONIC SYSTEMS	FILE NAME: BHS WDECO.MR4161A		TYPE: MULTI-ZONE RELAY CONTROL
DATE: 2/22/00	DRAWN BY: MJA	APPROVED BY:	FOR: COLUMBUS MODELS MR41AA, MR61AA

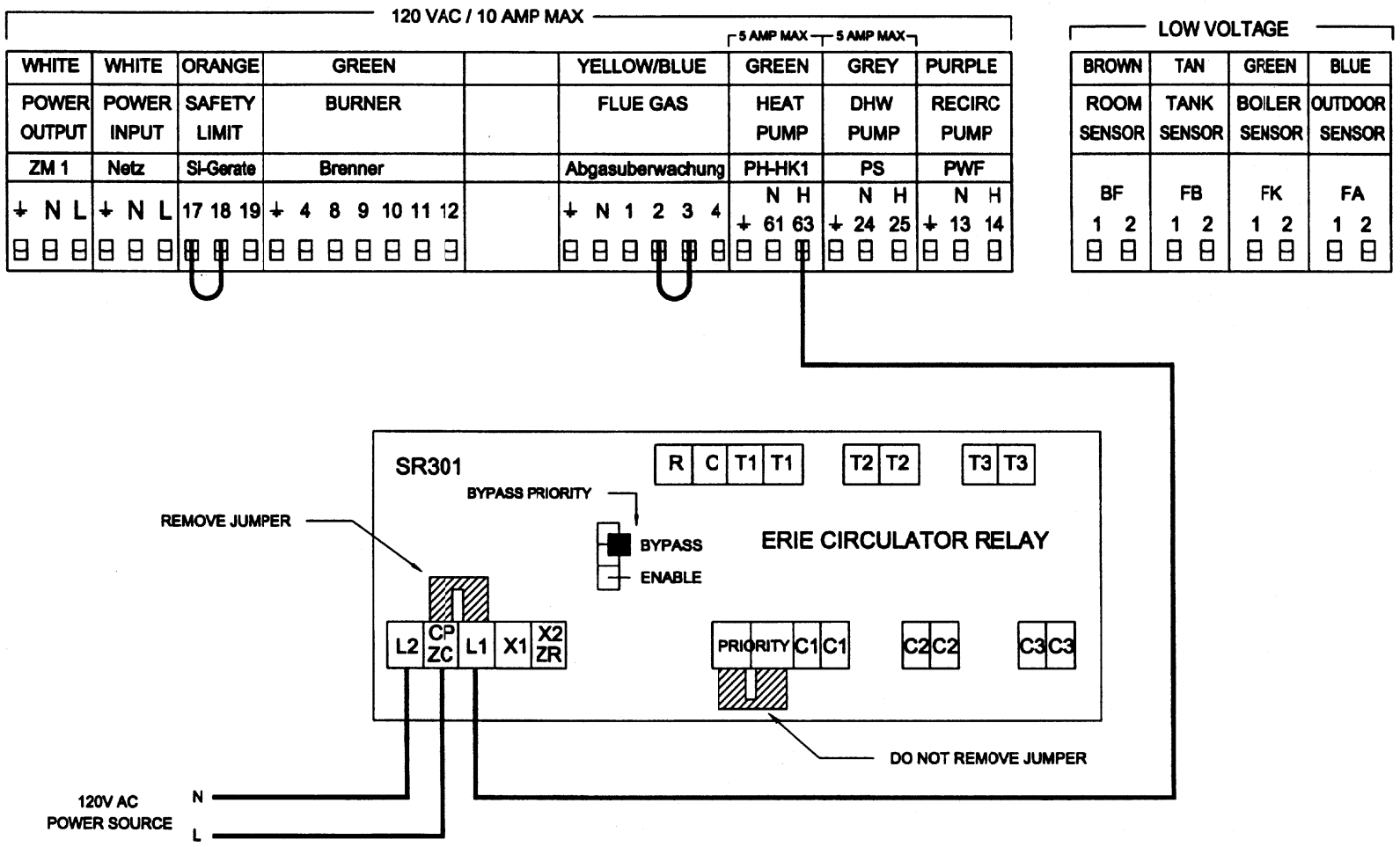
Control Wiring Terminals



***Note:** This drawing is conceptual in nature and does not purport to address all design, installation or safety considerations. Additional safety and/or auxilliary equipment may be needed. This diagram is for reference use by officials, designers and licensed installers. It is expected that installers have an adequate knowledge of accepted industry practices for the equipment, procedures and applications involved.*

BUDERUS HYDRONIC SYSTEMS	FILE NAME: BHS WDECO.MR31AA		TYPE: MULTI-ZONE RELAY CONTROL
DATE: 2/22/00	DRAWN BY: MJA	APPROVED BY:	FOR: COLUMBUS MODEL MR31AA

Control Wiring Terminals



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BUDERUS HYDRONIC SYSTEMS	FILE NAME: BHS WDECO.WSR301		TYPE: MULTI-ZONE RELAY CONTROL
DATE: 2/22/00	DRAWN BY: MJA	APPROVED BY:	FOR: ERIE MODELS SR201, 301, 601

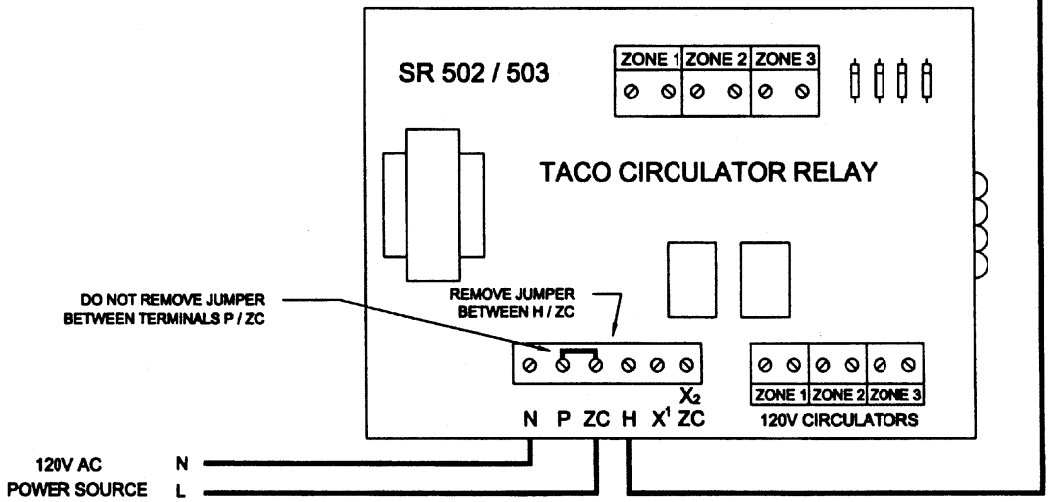
Control Wiring Terminals

120 VAC / 10 AMP MAX

WHITE	WHITE	ORANGE	GREEN		YELLOW/BLUE	GREEN (5 AMP MAX)	GREY (5 AMP MAX)	PURPLE
POWER OUTPUT	POWER INPUT	SAFETY LIMIT	BURNER		FLUE GAS	HEAT PUMP	DHW PUMP	RECIRC PUMP
ZM 1	Netz	Si-Gerate	Brenner		Abgasuberwachung	PH-HK1	PS	PWF
⏚ N L	⏚ N L	17 18 19	⏚ 4 8 9 10 11 12		⏚ N 1 2 3 4	N H ⏚ 61 63	N H ⏚ 24 25	N H ⏚ 13 14

LOW VOLTAGE

BROWN	TAN	GREEN	BLUE
ROOM SENSOR	TANK SENSOR	BOILER SENSOR	OUTDOOR SENSOR
BF 1 2	FB 1 2	FK 1 2	FA 1 2



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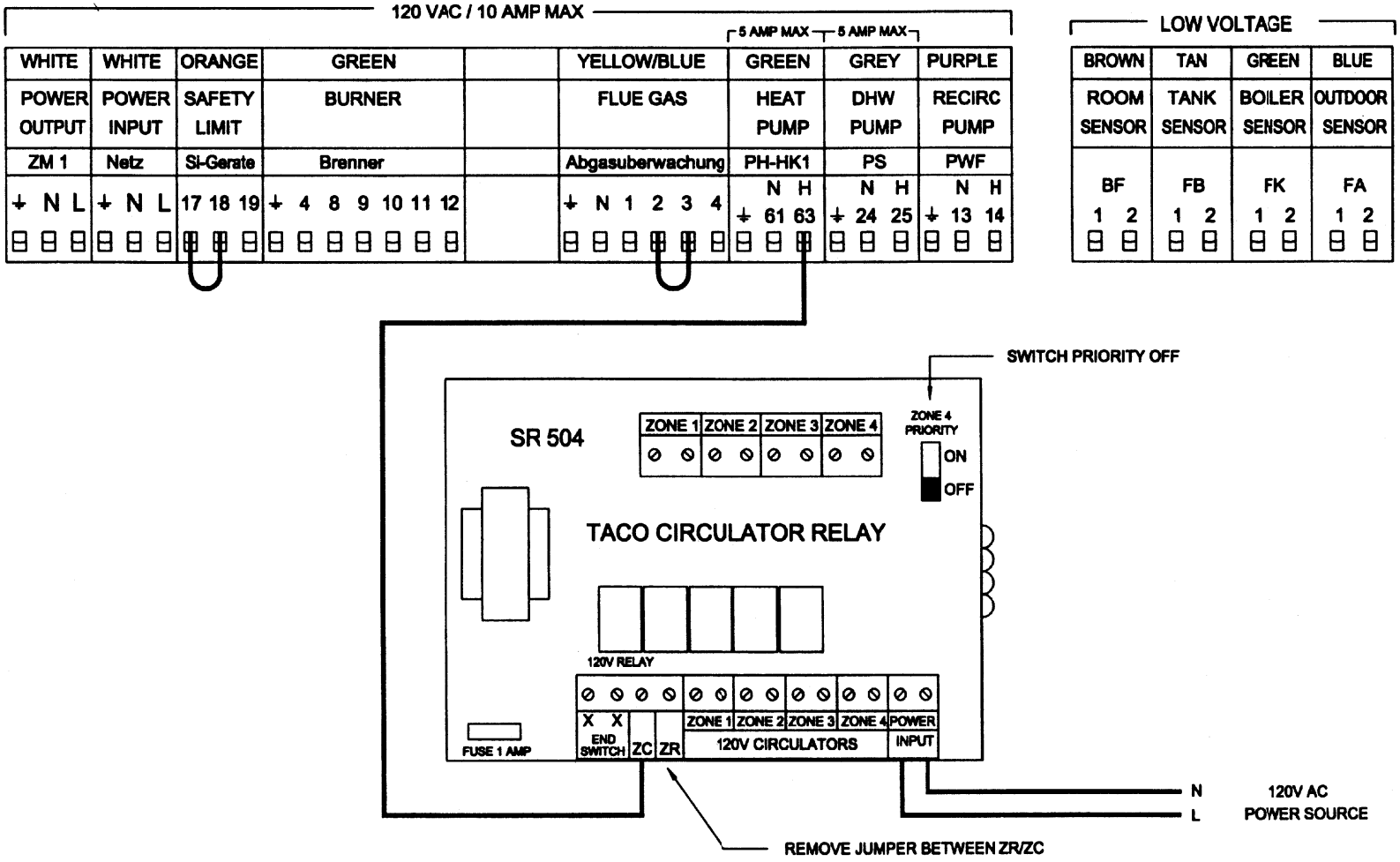
BUDERUS HYDRONIC SYSTEMS	FILE NAME: BHS WDECO.TASR502		TYPE: MULTI-ZONE RELAY CONTROL
DATE: 2/22/00	DRAWN BY: MJA	APPROVED BY:	FOR: TACO MODELS SR502, SR503

Control Wiring Terminals



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BUDERUS HYDRONIC SYSTEMS	FILE NAME: BHS WDECO.TASR504		TYPE: MULTI-ZONE RELAY CONTROL
DATE: 2/22/00	DRAWN BY: MJA	APPROVED BY:	FOR: TACO MODELS SR504, SR506 SR503-EXP, SR504-EXP, SR506-EXP

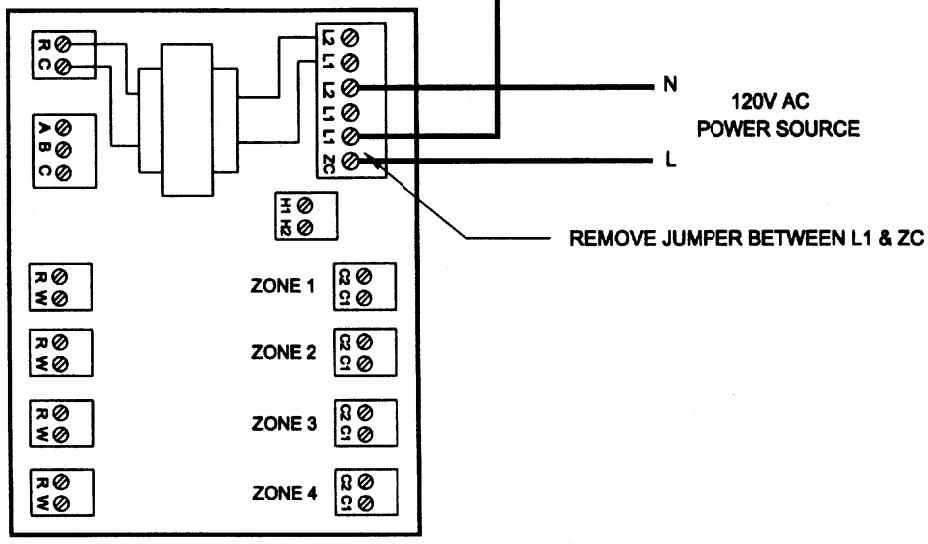
Control Wiring Terminals

120 VAC / 10 AMP MAX

WHITE	WHITE	CRANGE	GREEN		YELLOW/BLUE	GREEN (5 AMP MAX)	GREY (5 AMP MAX)	PURPLE
POWER OUTPUT	POWER INPUT	SAFETY LIMIT	BURNER		FLUE GAS	HEAT PUMP	DHW PUMP	RECIRC PUMP
ZM 1	Netz	SI-Gerate	Brenner		Abgasuberwachung	PH-HK1	PS	PWF
⏚ N L	⏚ N L	17 18 19	⏚ 4 8 9 10 11 12		⏚ N 1 2 3 4	N H ⏚ 61 63	N H ⏚ 24 25	N H ⏚ 13 14

LOW VOLTAGE

BROWN	TAN	GREEN	BLUE
ROOM SENSOR	TANK SENSOR	BOILER SENSOR	OUTDOOR SENSOR
BF	FB	FK	FA
1 2	1 2	1 2	1 2



HONEYWELL R8888A,B

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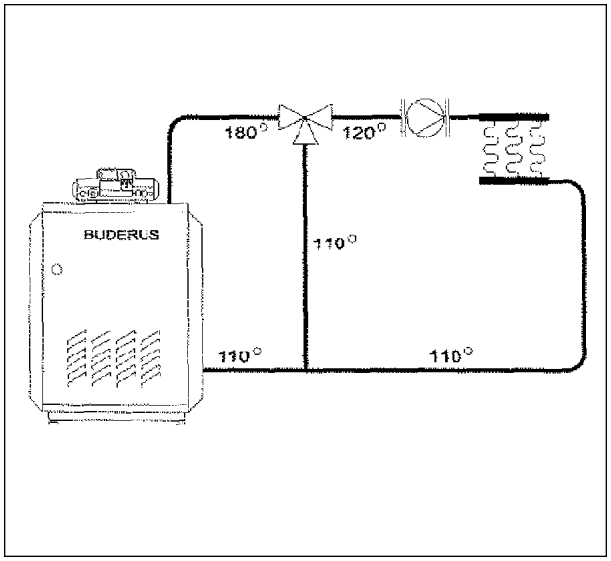
BUDERUS HYDRONIC SYSTEMS	FILE NAME: BHS WDECO.R8888A		TYPE: MULTI-ZONE RELAY CONTROL
DATE: 7/4/00	DRAWN BY: MJA	APPROVED BY:	FOR: HONEYWELL MODEL R8888A,B

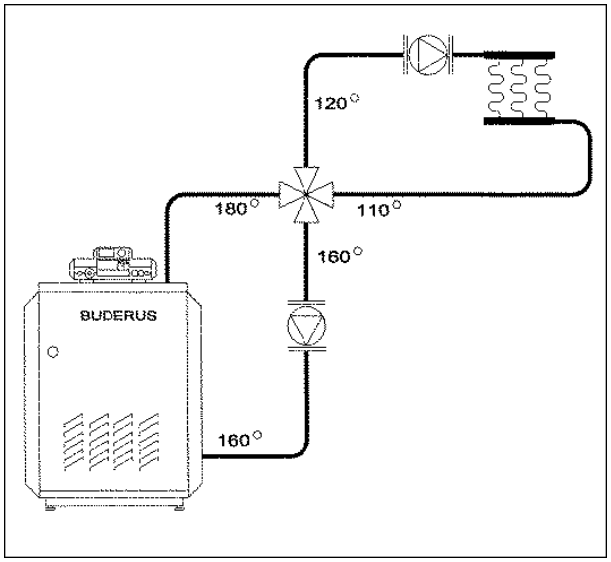
7 Mixing

MIXING VALVES

There are two types of mixing valves commonly used in hydronic heating systems, 3-port and 4-port. Both of these valves are used to mix return water from the system with water from the boiler. A motorized actuator is used to make adjustments to the valve positioning in order to maintain a given outlet temperature. This type of controlling provides very accurate control of water temperature to the system. It also allows the system water temperature to be reset based on changes in outdoor (and optionally indoor) temperature. Without the use of a motorized actuator, the outlet temperature of the valve is dependent on the flow rate and temperature of the incoming water. Using a manually set mixing valve without a motorized actuator can create wide swings in the outlet temperature.

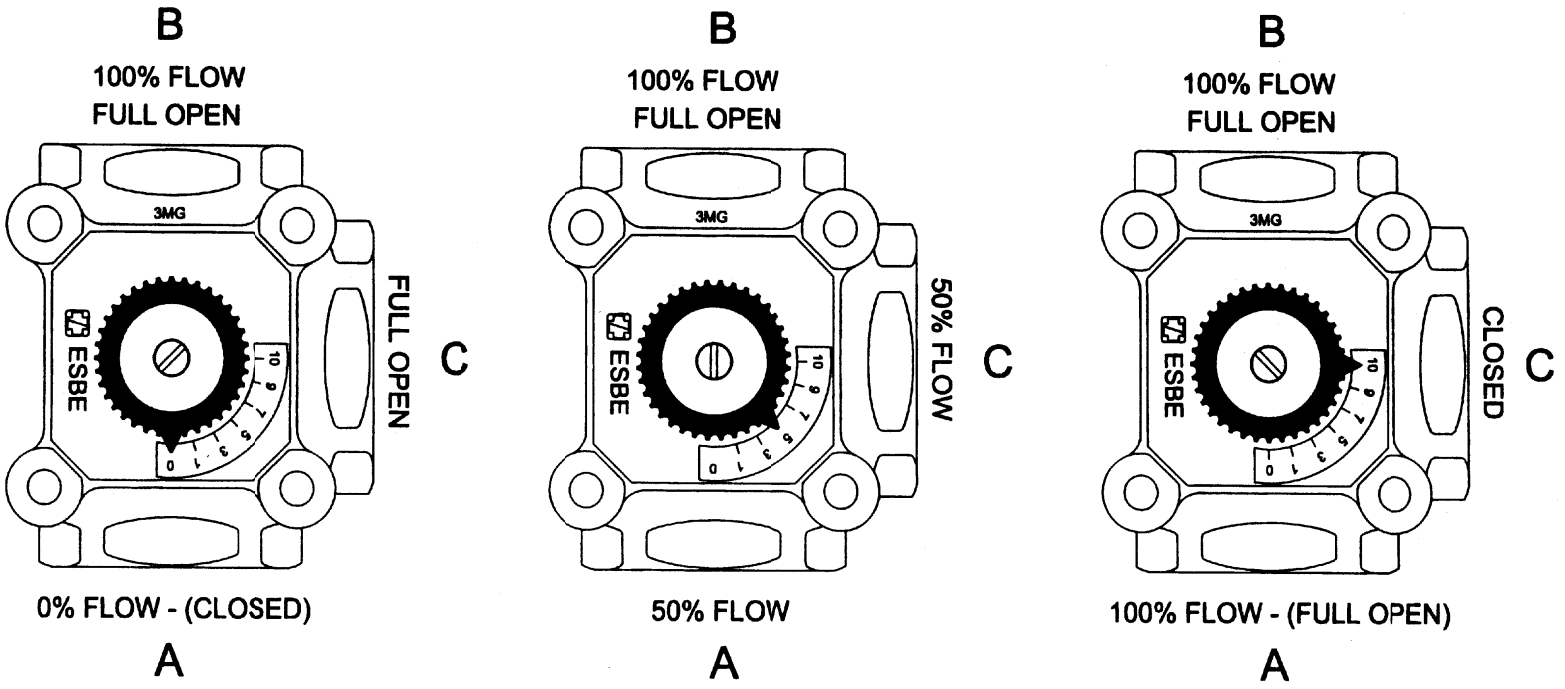


3-port valve - Three port mixing valves allow system water to return directly to the heat source. Buderus generally recommends the use of 3 way mixing valves when using a Buderus boiler. Due to the flexibility and corrosion resistance of the Buderus boiler and the condensate protection feature of the Buderus control system, cooler return water temperature does not present a problem.



4-port valve - Four port mixing valves allow cooler return temperatures from the system to be mixed with boiler temperature water resulting in higher return temperatures to the boiler. A boiler loop pump must be used in order to ensure this mixing of temperature. Most cast iron boilers require this higher return temperature to guard against thermal shock and flue gas condensation. 4-port valves are recommended in applications were there is a large volume of low temperature system water. This will reduce pump cycling on system start up and prolonged setback periods.

FLOW THROUGH 3-WAY MIXING VALVE AT VARIOUS POSITIONS.



A - FROM BOILER

B - TO RADIANT SYSTEM

C - FROM RADIANT SYSTEM

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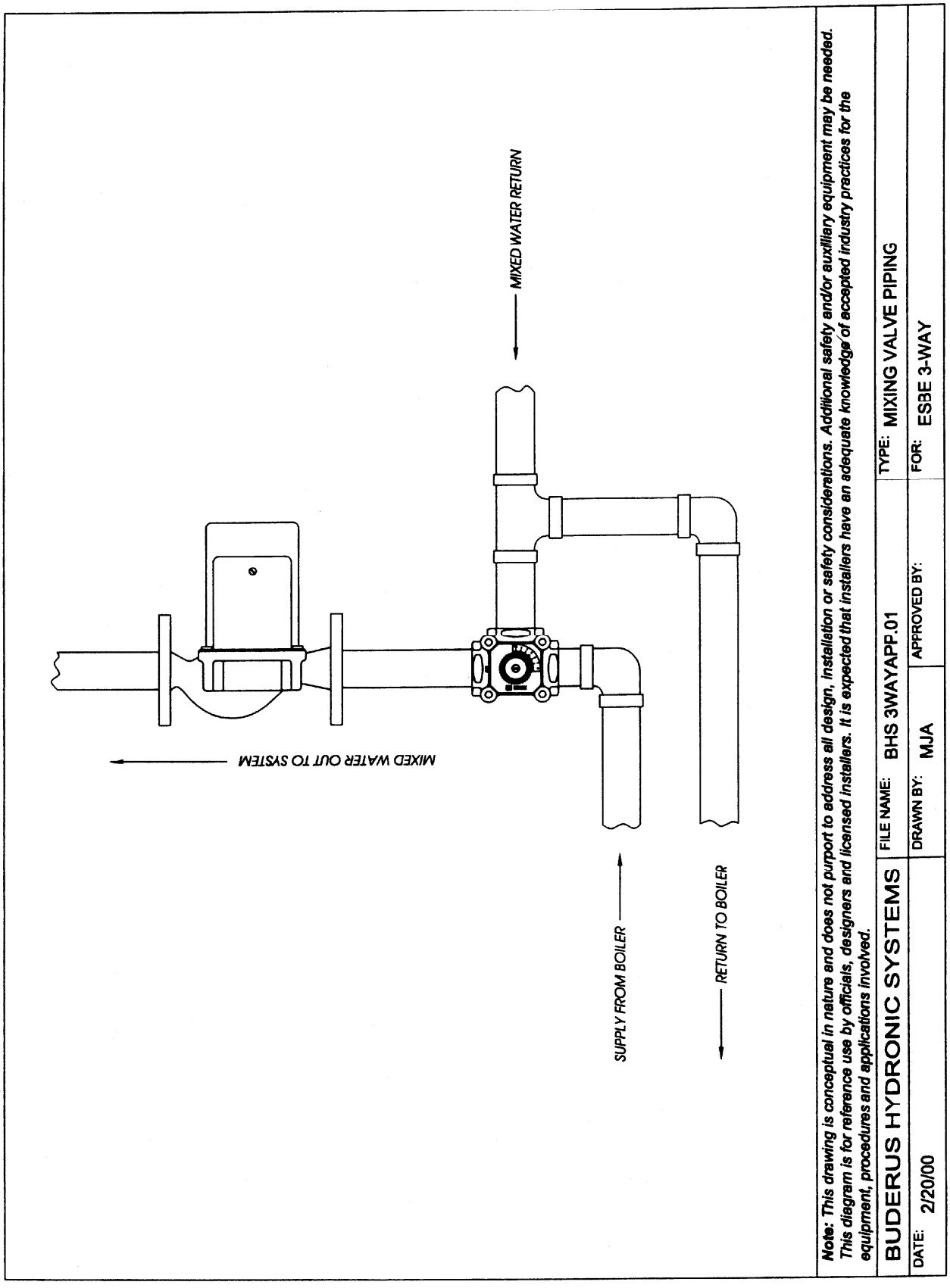
BUDERUS HYDRONIC SYSTEMS	FILE NAME: BHS 3WAY.1		TYPE: 3-WAY MIXING VALVE
DATE: 2/20/00	DRAWN BY: MJA	APPROVED BY:	FOR: FLOW THROUGH VALVE



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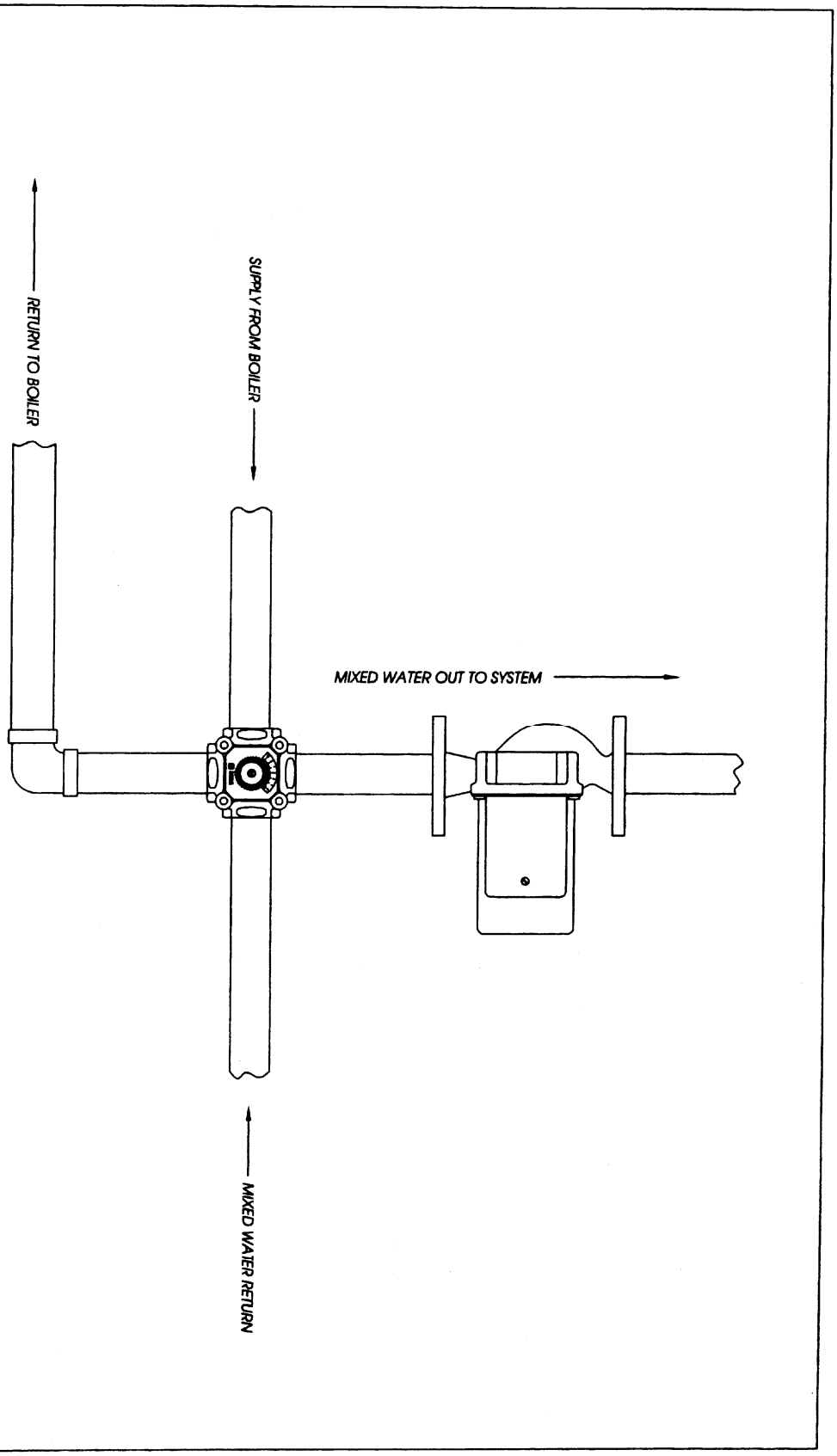
BUDERUS HYDRONIC SYSTEMS	FILE NAME: BHS 3WAYAPP.01	TYPE: MIXING VALVE PIPING
DATE: 2/20/00	DRAWN BY: MJA	APPROVED BY:	FOR: ESBE 3-WAY



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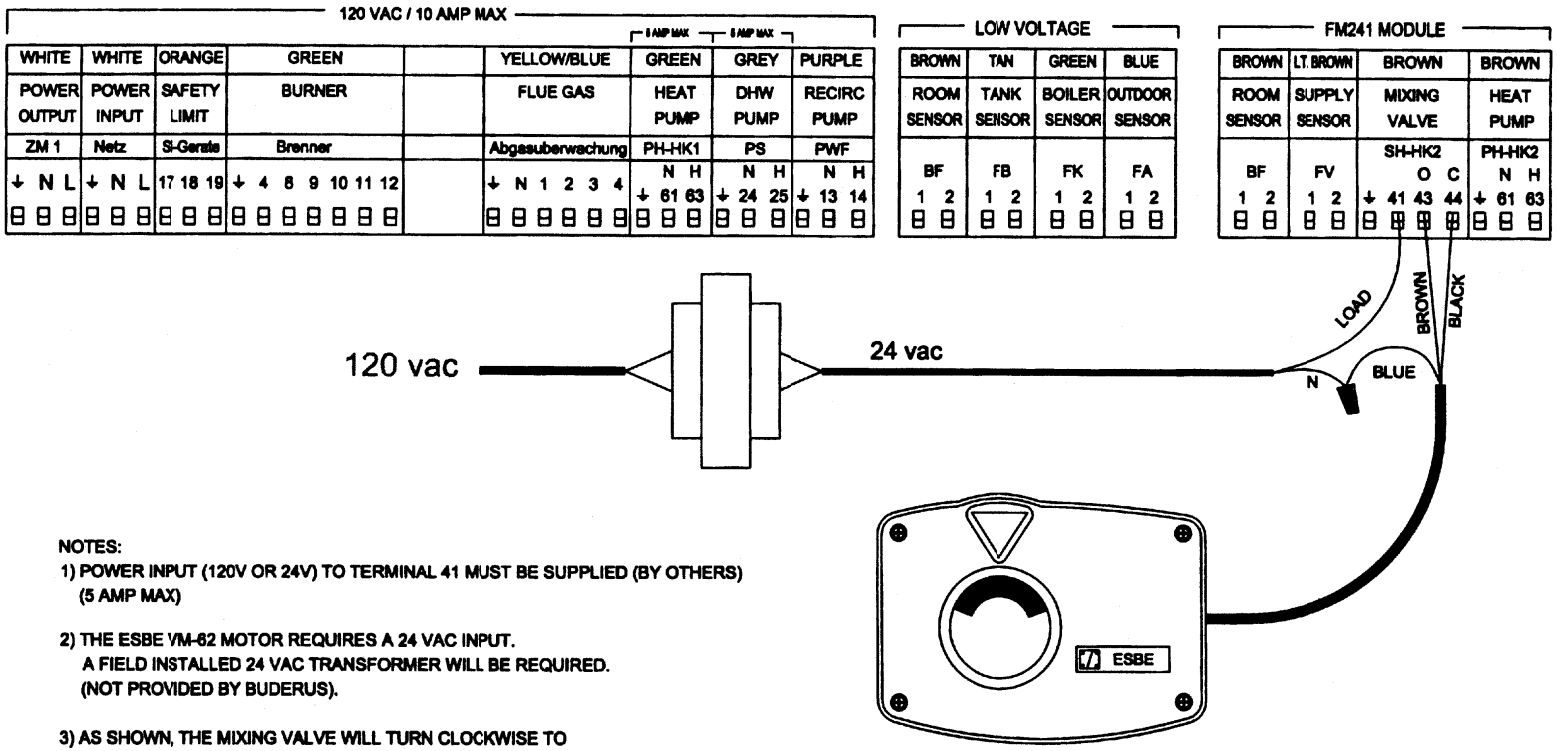
BUDERUS HYDRONIC SYSTEMS	FILE NAME: BHS 4WAYAPP.01		TYPE: MIXING VALVE PIPING
DATE: 2/20/00	DRAWN BY: MJA	APPROVED BY:	FOR: ESBE 4-WAY

Control Wiring Terminals



NOTES:

1) POWER INPUT (120V OR 24V) TO TERMINAL 41 MUST BE SUPPLIED (BY OTHERS) (5 AMP MAX)

2) THE ESBE VM-62 MOTOR REQUIRES A 24 VAC INPUT. A FIELD INSTALLED 24 VAC TRANSFORMER WILL BE REQUIRED. (NOT PROVIDED BY BUDERUS).

3) AS SHOWN, THE MIXING VALVE WILL TURN CLOCKWISE TO OPEN. DEPENDING UPON VALVE POSITIONING, YOU MAY REQUIRE THE MOTOR TO TURN COUNTER-CLOCKWISE TO OPEN. THIS IS DONE BY SWITCHING THE BROWN AND BLACK WIRES AT THE FM241 MODULE.

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BUDERUS HYDRONIC SYSTEMS	FILE NAME: BHS VM62.01		TYPE: MIXING VALVE MOTOR WIRING
DATE: 3/19/00	DRAWN BY: MJA	APPROVED BY:	FOR: ESBE VM-62

7 Mixing

VARIABLE FLOW INJECTION MIXING

The Buderus FM241 module used in conjunction with a 2-way injection valve offers an alternative to either motorized mixing valve operation or variable speed pump injection for fine-tuned control of a radiant floor heating system. This method of mixing provides very accurate control of water temperature to the system. As with motorized mixing valves, this type of controlling also allows the system water temperature to be reset based on changes in outdoor (and optionally indoor) temperature.

Description:
System inputs consist of the outdoor sensor (FA) of the Buderus HS2105 and the strap-on sensor (FV) mounted on the supply side of the radiant floor system. Optionally, a BFU room sensor can be used for indoor temperature feed back for further fine-tuning of the system water temperature. These inputs are processed by the control and compared to the reset curve: as a result the HS2105 control powers the injection valve actuator as needed to provide accurate water temperature control.

Two methods of injection piping are commonly used:

Primary/Secondary injection - this method creates a boiler loop around the boiler allowing cooler return temperatures from the system to be mixed with boiler temperature water resulting in higher return temperatures to the boiler. A boiler loop pump must be used in order to ensure this mixing of temperature. A circulator is installed in the boiler loop to create a constant flow of boiler temperature water around the boiler loop. Two closely spaced tees form the supply and return of the variable flow injection mixing system (see FIG 1). The following piping practices must be considered:

1) Maintain a maximum of 4 pipe diameter distance between the tees in the boiler loop.
2) Maintain a minimum of 6 pipe diameters of straight pipe on both sides of the tees to prevent momentum induced flow into the injection system.
3) Install a thermal trap with a minimum of 18" height on the return side of the injection system piping.
4) Install a properly sized balancing valve on the system loop. A globe type valve is recommended for fine regulation and long service life.

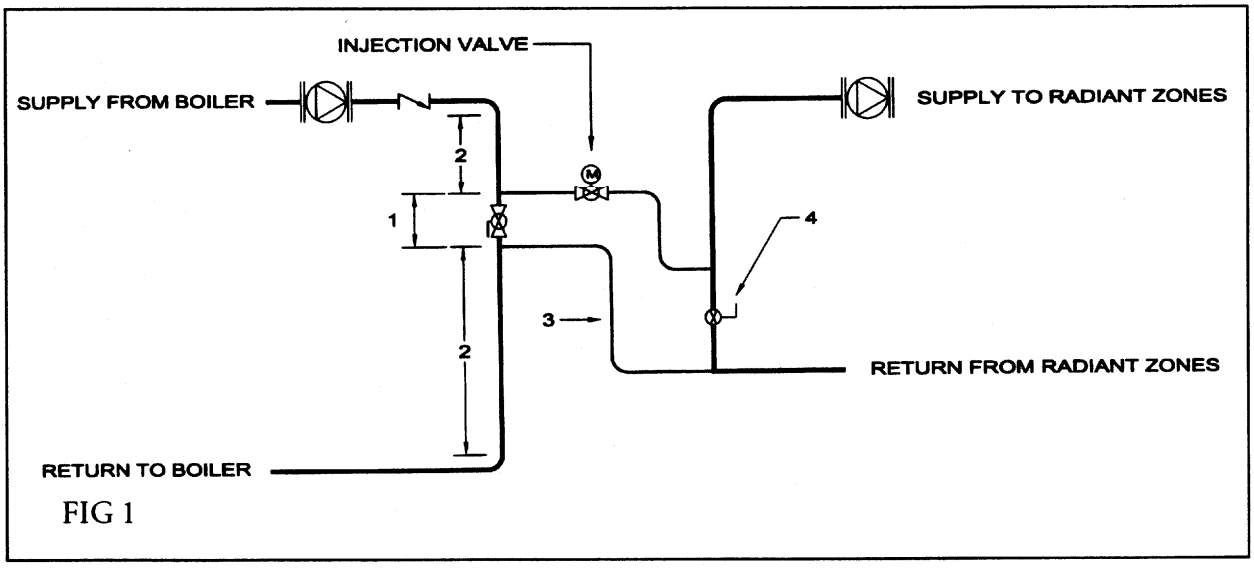


FIG 1

VARIABLE FLOW INJECTION MIXING

Direct injection - in this method the variable flow injection mixing system is piped as a separate zone from the main boiler supply manifold, with a check valve installed to prevent reverse flow in the radiant system when the pump is not operating. This method allows direct return of radiant system water to the boiler. A boiler loop pump is not required. (see FIG 2).

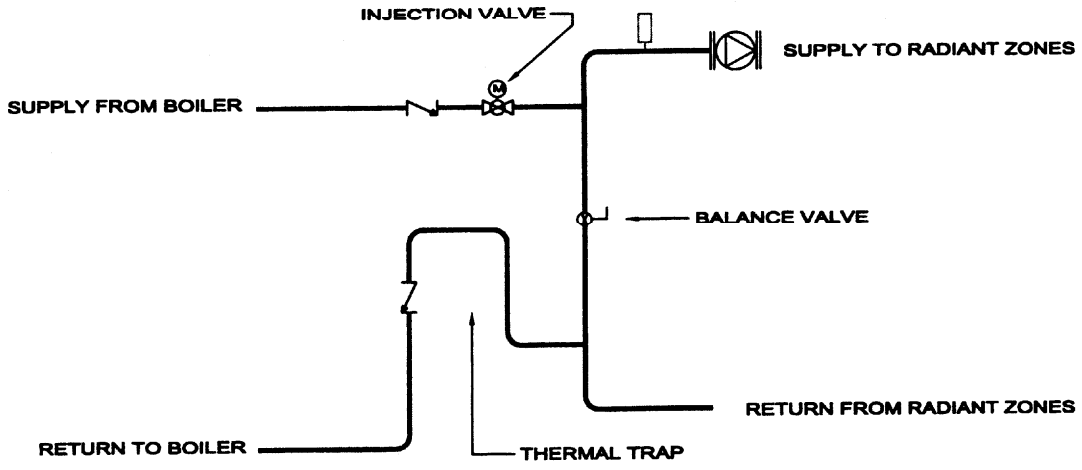


FIG 2

7 Mixing

SYSTEM DESIGN CONSIDERATIONS

The following design procedure assumes that the boiler water temperature requirement exceeds the temperature requirements for the radiant system.

1) Determine the following parameters:
   Maximum boiler supply temperature: T_b
   Maximum radiant temperature: T_r
   Radiant system temperature drop: $\triangle T_r$
   Radiant Heat Load: Q_r

2) Determine radiant flow rate: $$GPM_r = \frac{Q_r}{(500) \text{ X } \triangle T_r}$$

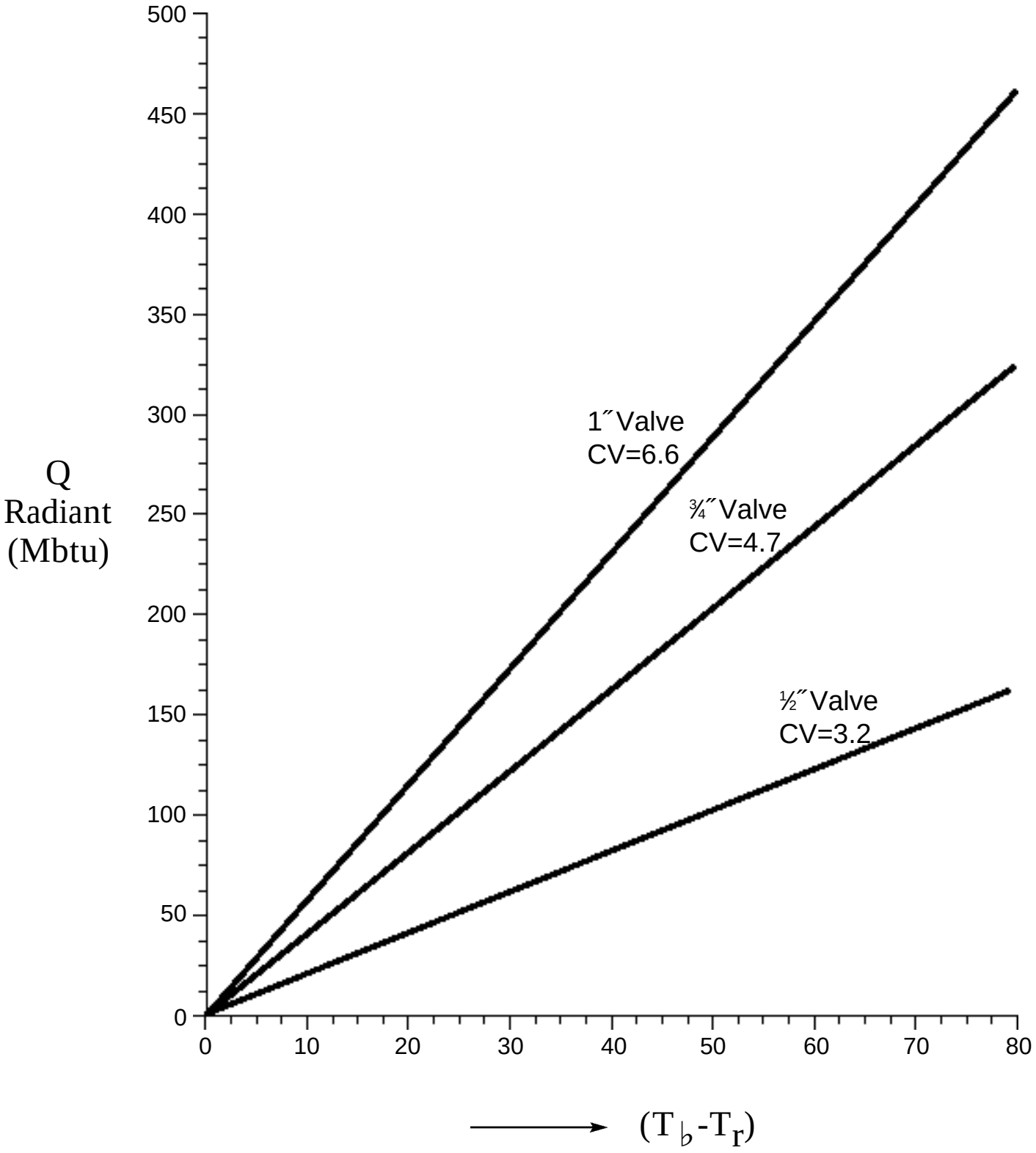
3) Determine driving temperature difference $T_b - T_r$

4) Determine the injection flow ratio $$\frac{\triangle T_r}{T_b - T_r + \triangle T_r}$$

5) Compute injection flow rate Flow ratio X GPM_r

6) Select the proper size Variable Flow Injection Valve using sizing chart.

7) Compare CV Value with flow rate


Q
Radiant
(Mbtu)
500
450
400
350
300
250
200
150
100
50
0
0
10
20
30
40
50
60
70
80
1˝Valve
CV=6.6
¾˝Valve
CV=4.7
½˝Valve
CV=3.2
(T b-T r)

7 Tables/Formulas

Flow Rate Calculations For Water

BTUH	Temperature Drop		
	10	20	30
	GPM		
5,000	1	0.5	0.33
6,000	1.2	0.6	0.4
7,000	1.4	0.7	0.47
8,000	1.6	0.8	0.53
9,000	1.8	0.9	0.6
10,000	2	1	0.67
15,000	3	1.5	1
20,000	4	2	1.3
25,000	5	2.5	1.7
30,000	6	3	2
35,000	7	3.5	2.3
40,000	8	4	2.7
45,000	9	4.5	3
50,000	10	5	3.3
55,000	11	5.5	3.7
60,000	12	6	4
65,000	13	6.5	4.3
70,000	14	7	4.7
75,000	15	7.5	5
80,000	16	8	5.3
85,000	17	8.5	5.7
90,000	18	9	6
95,000	19	9.5	6.3
100,000	20	10	6.7
110,000	22	11	7.3
120,000	24	12	8
130,000	26	13	8.7
140,000	28	14	9.3
150,000	30	15	10
160,000	32	16	10.7
170,000	34	17	11.3
180,000	36	18	12
190,000	38	19	12.7
200,000	40	20	13.3
210,000	42	21	14
220,000	44	22	14.7
230,000	46	23	15.3
240,000	48	24	16
250,000	50	25	16.7
260,000	52	26	17.3
270,000	54	27	18
280,000	56	28	18.7
290,000	58	29	19.3
300,000	60	30	20
350,000	70	35	23.3
400,000	80	40	27.7
450,000	90	45	30
500,000	100	50	33.3

*Add 15% to flow rate for 50/50 Glycol solution

Maximum Recommended Flow Rates For Hydronic Heating

Copper Tubing	GPM	Steel Pipe	GPM
½	1½	½	2
¾	4	¾	4
1	8	1	8
1¼	14	1¼	16
1½	22	1½	25
2	45	2	50
2½	85	2½	80
3	130	3	140

Mixing Valve Sizing

GPM (Radiant System)	ESBE 3-Way	ESBE 4-Way
1 to 8	3/4″	3/4″
9 to 14	1″	1″
15 to 22	11/4″	11/4″
23 to 40	11/2″	11/2″
41 to 60	2″	2″
61 to 125	*21/2″	*21/2″
126 to 200	*3″	*3″

*Requires VM83 motor and VL800 linkage

Approximate Heat Output For Fin-Tube Baseboard

Average Water Temp (F)	Btu/Hr Per Lineal Ft @ 1GPM Flow Rate
90	65
100	106
110	156
120	209
130	262
135	290
140	320
150	380
160	450
170	510
180	580

Conversions/Formulas

GPM	=	$\frac{\text{BTU/hr}}{500 \times \text{Delta T (Degrees F)}}$
BTU/hr	=	500 x GPM x Delta T (Degrees F)
Pressure (PSI)	=	$\frac{\text{Head (Feet)} \times 1 \text{ (Specific Gravity)}}{2.31}$
Head (Feet)	=	$\frac{\text{Pressure (PSI)} \times 2.31}{1 \text{ (Specific Gravity)}}$
Fahrenheit	=	(Degrees Celsius x 1.8) + 32
BTU/hr	=	Kilowatts x 3,413

Recovery time for an indirect water heater

$$\frac{Q}{\text{Boiler Output (BTU/hr)}}$$

Q(Load) = 8.31 (lbs/gal water) x Delta T x Gallons

Example: 53 gallon tank + 85,000 Btu/hr boiler
8.31 x 90 (degrees Rise) x 53 (gallons) = 39,639
39,639 / 85,000 (bth/hr) = .466 (hour)
60 (minutes/hr) x .466 = 28 (minutes)

Temperature drop through a series loop

New Supply temperature = Previous Supply Temperature - $\frac{Q \text{ (Radiator)}}{500 \times \text{Loop GPM}}$

Example:
Loop GPM = 2.5 Q(Radiant Output) = 4,000 BTU Starting Supply Temp = 180 degree
180 -(4,000/500 x 2.5) = 176.8 degree (New supply temperature)

Heat Values	
Natural Gas	1 therm = 100,000 btu
#2 Oil	1 gallon = 139,000 btu
Propane	1 gallon = 91,800 btu

Notes

Notes

Notes

Boiler installed by:
(contractor's address)

Boiler installed on:
(date of installation)

Buderus
HYDRONIC SYSTEMS

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