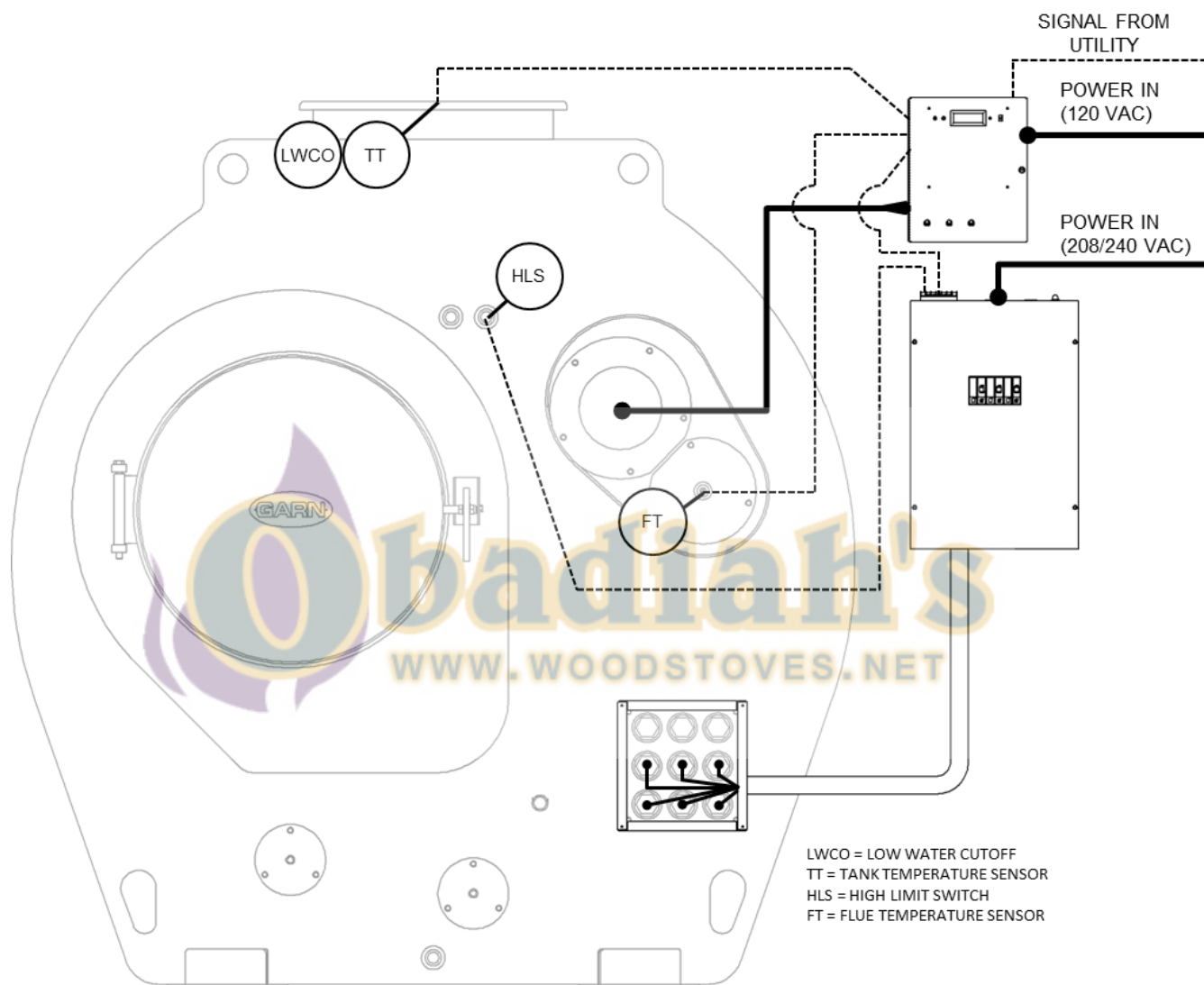


GARN® Electric Heating Package Owner's Manual



OWNER'S MANUAL FOR THE GARN® WHS ELECTRIC HEATING PACKAGE

Thank you for purchasing GARN® equipment. Carefully read this manual. It contains instructions about how to install, operate, and maintain your GARN® WHS Electric Heating Package. Please compare your packing list with the delivered items. Contact your dealer and shipper immediately if any items are missing or damaged.

TABLE OF CONTENTS

A. PURPOSE OF THIS MANUAL:	3
B. EQUIPMENT, COMPONENTS, AND CONTROLS OVERVIEW:	3
AVAILABLE HEATING PACKAGE SIZES:	3
WHAT IS PROVIDED WITH THE ELECTRIC HEATING PACKAGE?:	3
SCHEMATIC DIAGRAM OF EQUIPMENT, COMPONENTS, AND CONTROLS:	5
C. CODES, INSURANCE, AND SAFETY SYMBOLS	6
D. INSTALLATION	7
ELECTRIC ELEMENTS	7
ELECTRIC ELEMENT BOX	7
SEQUENCER	10
DUAL SEQUENCERS	11
E. OPERATION:	12
WOOD OR ELECTRIC/WOOD OPERATION	12
TEMPERATURE SETPOINT ADJUSTMENT	13
DIAL SWITCH POSITIONS	14
OUTDOOR RESET CURVE (USED WITH DIAL POSITION 1)	15
F. WIRING DIAGRAMS:	16
WHS/ETS DIGITAL CONTROLLER	16
SEQUENCER – 16.5 kW	17
SEQUENCER – 33.0 kW	19
SEQUENCER – 49.5 kW	20
IDENTIFYING YOUR BOARD REVISION	21
IDENTIFYING YOUR CHIP REVISION	21
CONTROLLER TO SEQUENCER WIRING – BOARD REV: UPC7115-A	22
CONTROLLER TO SEQUENCER WIRING – BOARD REV: UPC7115-C	23
CONTROLLER TO OFF-PEAK METER WIRING	24
USING AN AQUASTAT TO SET A CUSTOM DEADBAND AND SETPOINT	26
G. WARRANTY	27

A. PURPOSE OF THIS MANUAL:

This manual is intended to be a reference for both the owner and the electrician/installer of the GARN Electric Heating Package. It provides the following information:

- Overview of operation and control logic
- Wiring diagrams and control schematics
- Answers to commonly asked questions

GARN has made off-peak heating equipment since the early 1980's. Off-peak heating works well with GARN wood equipment because the thermal storage is already built into the unit. Although the specific configurations of the GARN electric heating controls and packaging has been revised over the years, the operational philosophy and the way in which the controls physically interact with the utility has remained nearly unchanged. That means, that this manual can be applied to virtually any electric heating equipment system GARN has ever produced. But, the manual is specifically tailored towards the most recent revisions of controls and packaging.

B. EQUIPMENT, COMPONENTS, AND CONTROLS OVERVIEW:

Every GARN® WHS is shipped with 9 threaded electric element flanges in the lower-right corner of the front head/face of the unit. The flanges provide the opportunity to purchase the electric heating package and turn the GARN® WHS unit into an electric heating system. Electric heating can be used in conjunction with wood heating to provide a dual-fuel heating system. There are 3 electric heating package sizes to choose from. The correct size for your application depends on the utility/coop off-peak electric program, heating load, and GARN WHS unit size.

AVAILABLE HEATING PACKAGE SIZES:

Electric Heating Package Size	Number of Electric Elements
16.5 kW	3
33.0 kW	6
49.5 kW	9

WHAT IS PROVIDED WITH THE ELECTRIC HEATING PACKAGE?:

The Complete GARN Electric Heating Package comes standard with the following components:

- Electric Elements (3, 6, or 9 depending on heating package size selected)
- O-rings for elements
- Electric Element Junction Box
- Electric Element Junction Box Face Gasket
- Electric Element Junction Box Cover, Label, and Fasteners
- Element Sequencer (powers the elements on one-at-a-time)
- High Limit Switch
- Newest available Processor Chip for the Digital Controller

There are 4 main components that work together to create the GARN Electric Heating Package:

1. WHS/ETS digital controller (supplied by GARN)

The digital controller receives a signal from the utility indicating that off-peak power is available and then sends a signal to the sequencer to turn on the elements if certain criteria are met. The name “GARN WHS/ETS” on the digital controller label is derived from two acronyms: “Wood Heat Storage” and “Electric Thermal Storage”

2. Sequencer (supplied by GARN)

The sequencer turns the elements on one after another to provide a gradual power-up. The sequencer is composed of a series of breakers and time-delay relays. Power to the sequencer is supplied from an electrical panel (or directly from a utility meter) and is connected to the breakers inside of the sequencer. Then a pair of conductors is wired from the output contacts of the time delay relays to each element. One time-delay relay serves one element.

A single sequencer can serve up to 33.0 kW. In the case of the 49.5 kW package, 2 sequencers are provided and both must be field installed and wired.

NOTICE

Two (2) sequencers are provided with the 49.5 kW package.

3. Electric Elements and Element Box (supplied by GARN)

The Electric Elements are made of Incoloy®, a high-grade nickel and chromium alloy. The electric resistive elements are embedded in a lime and sand mixture inside of the Incoloy casing. The elements are Low-Watt Density which provides the safest and most robust option for heating with electricity.

4. Power Supply for Electric Elements (from Electric Panel or directly from a Utility meter) (supplied by others – usually the utility)

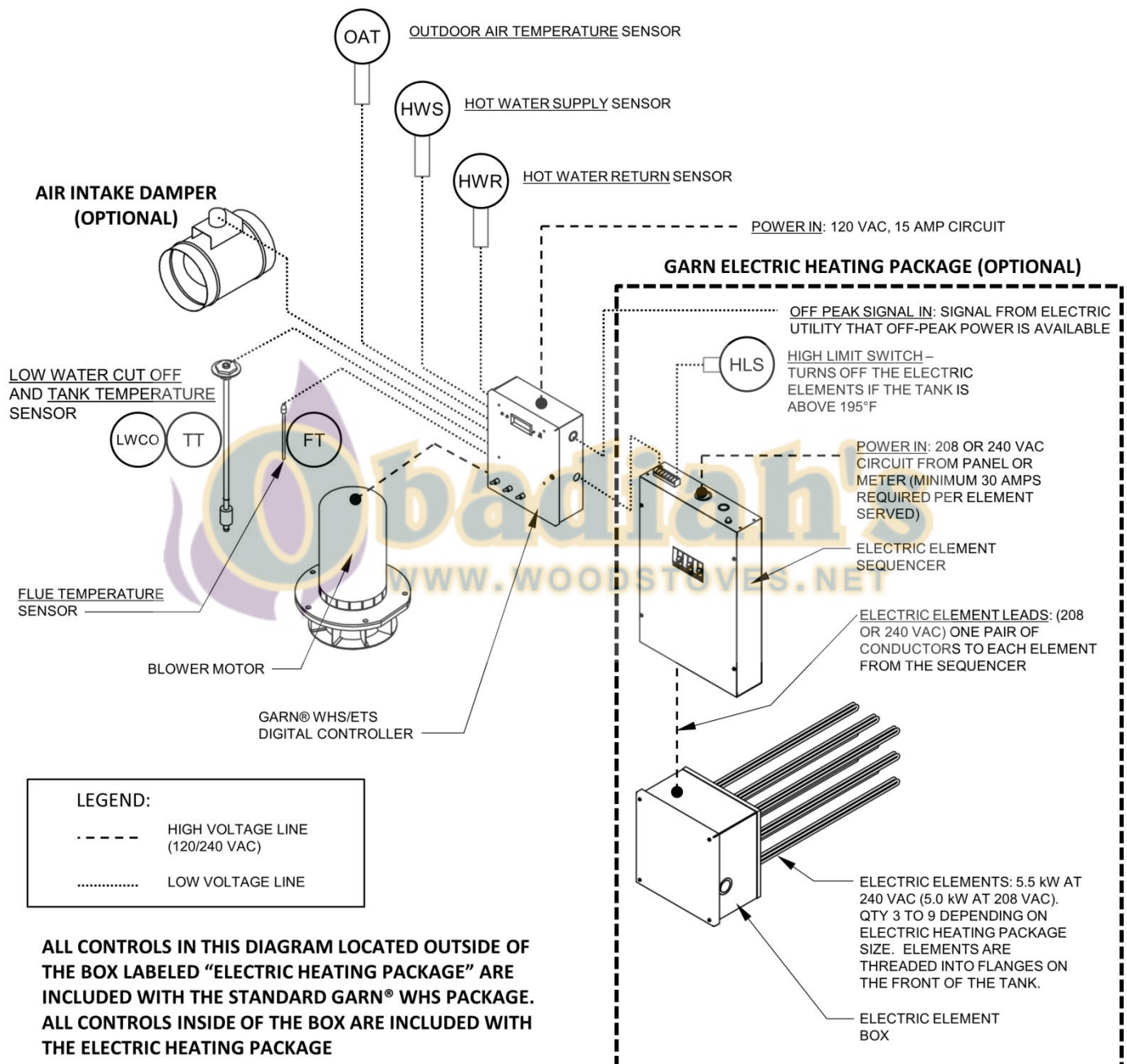
The power source for the electric elements must come from a building electrical panel or directly from a utility meter. The power is supplied to the sequencer, and the sequencer then distributes the power to the elements. If power is being supplied by a panel, then the panel must be properly sized and rated for the power draw of the electric heating package being installed.

NOTICE

The specific type of utility meter can vary based on the utility supplying the meter and the programs they offer: Smart Meter, Time-of-Day Meter, Off-Peak Meter, etc.

SCHEMATIC DIAGRAM OF EQUIPMENT, COMPONENTS, AND CONTROLS:

The diagram below shows a schematic overview of the Electric Heating Package and how it interfaces with the standard GARN Wood Heating Package. The diagram indicates what is provided with the Electric Heating Package and calls out the names of each of the components.



C. CODES, INSURANCE, AND SAFETY SYMBOLS

The GARN® WHS Wood Heat Storage is listed by ITS/Warnock Hersey Testing Laboratory, Madison, Wisconsin according to ANSI/UL-391, UL-726 and CAN/USA B366.1-11. Install the GARN® ETS Electric Thermal Storage according to this manual, on-line technical bulletins, Federal, State and local codes, and your insurance underwriter's guidelines.



The GARN® unit, all related heating equipment (including pumps, piping, fan coils, hot water baseboard, radiant floor heating systems, etc), and all electrical equipment (including power wiring, controls, control wiring, back up electric heating, etc) must be installed by a qualified installer or licensed personnel in strict compliance with all Federal, State and local codes.



THE WIRING AND INSTALLATION OF THE GARN® ETS ELECTRIC HEATING PACKAGE SHALL BE COMPLETED BY A CURRENTLY LICENSED ELECTRICIAN IN FULL COMPLIANCE WITH ALL SECTIONS OF NEC, FEDERAL, STATE AND LOCAL CODES. The installer must keep in mind the following:

- All electrical equipment, devices and wiring installed with the GARN® unit must be UL/CSA listed. The installer is to supply and install all code required electrical overcurrent and disconnect devices.
- All wiring, controls, relays, transformers, enclosures, etc shall be UL/CSA listed and comply with NEC Class 1 600 V requirements.
- As a minimum all power wiring shall be 10 ga 600 VAC 105 C, tinned plated stranded copper.
- All “female crimp connectors” shall be high temperature UL/CSA listed for electric heating equipment (such as [Hollingsworth SO9300](#)) and shall be installed utilizing the correct crimp tool. DO NOT USE standard crimp connectors as they will fail due to heat.
- All wiring shall be in metallic conduit, sized per NEC with proper de-rating.

This manual is intended to comply with NEMA Z535.6-2006 (the standard for *Product Safety Information in Product Manuals, Instructions, and Other Collateral Material*). Throughout the manual, a series of safety symbols are intended to call to attention the following types of information:



A **notice** provides a piece of information to make a procedure/process easier or clearer.



A **caution** emphasizes where equipment damage might occur. Personal injury is not likely.



A **warning** emphasizes areas where personal injury or death may occur but is not likely. Property or equipment damage is likely.



A **danger** emphasizes areas or procedures where death, serious injury, or property damage is likely if not strictly followed.

D. INSTALLATION

ELECTRIC ELEMENTS

Electric resistance heating elements are rated for 240 VAC or 208 VAC. Power to each element must be supplied by a UL/CSA listed individual two-pole breaker with a common trip.

- 1.) Mount the electric heating elements in the 1" NPT fittings in the element box. Each element has an O-ring for proper sealing into its threaded plug. In addition, use Teflon tape to seal the threads of the elements.

NOTICE

DO NOT USE PIPE DOPE COMPOUNDS ON THE TREADS WHEN INSTALLING THE ELECTRIC ELEMENTS. The pipe dope lubricates the o-rings and may cause them to dislodge.

- 2.) Install the elements in the lowest fittings possible to maximize storage. Plug any unused fittings with 1" NPT plugs (use pipe dope or teflon tape to seal).



ONLY CONNECT STEEL CONDUIT TO THE ELEMENT BOX AS IT MAY REACH TEMPERATURES IN EXCESS OF 200°F.

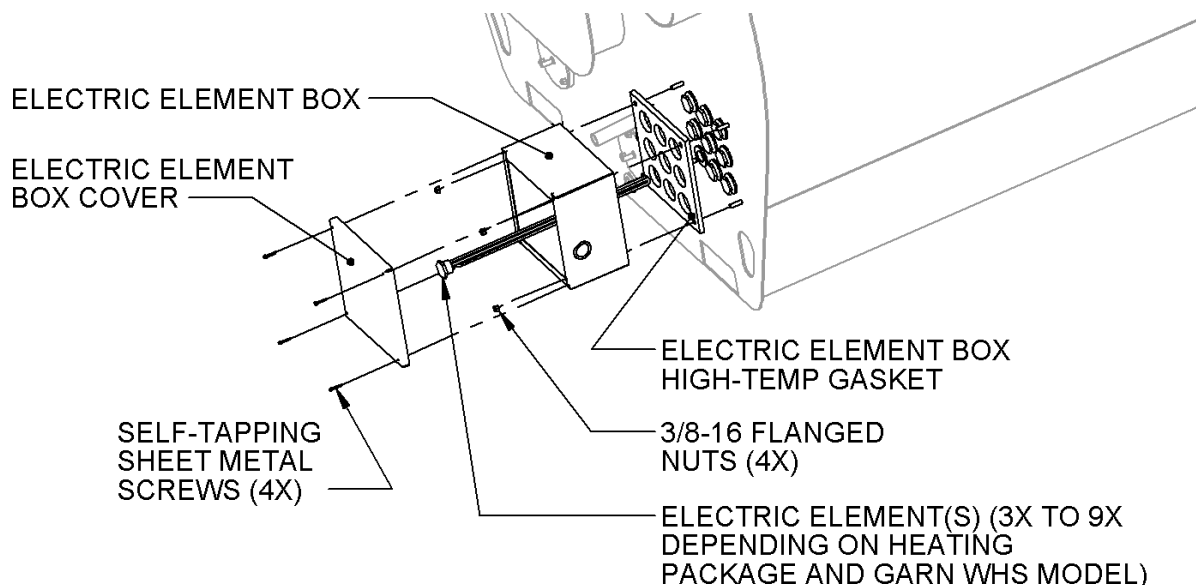
- 3.) Fill the tank with enough water to cover the elements and test for leaks.

NOTICE

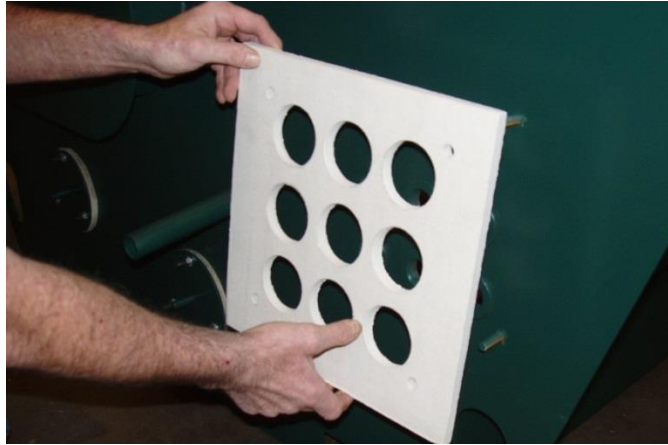
ONLY OPERATE THE ELECTRIC ELEMENTS WHEN SUBMERGED IN WATER. If they are turned on out of water they may burn out and require replacement.

ELECTRIC ELEMENT BOX

The tank-mounted junction box comes with a high-temperature insulation gasket, UL/CSA listed box, box cover, fasteners and labels.



- 1) Follow the installation instructions in this manual for [Installing the Electric Elements](#). Ensure that electric elements or 1'NPT plugs are installed and test for leaks.
- 2) Place insulation pad over the bolts extruding from the tank.



- 3) Align the junction box with the bolts and push against the insulation gasket.



- 4) With the nuts provided, tighten the box against the gasket until the gasket compresses slightly.



- 5) Affix the cover after leak testing and electrical installation.



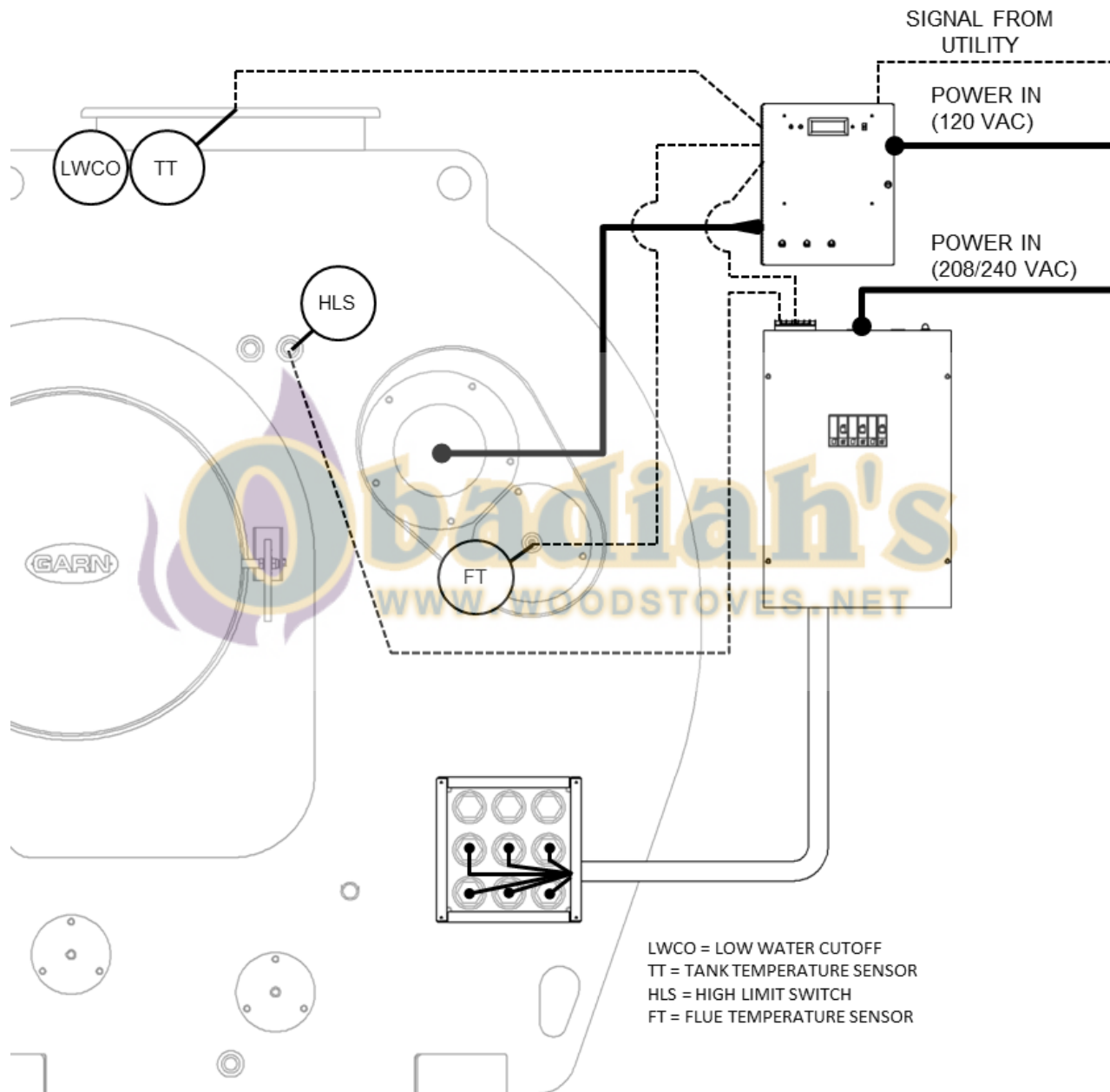
NOTICE

The label on the cover of the Element Box contains information about field wiring and safety notes. Follow the instructions on the label.



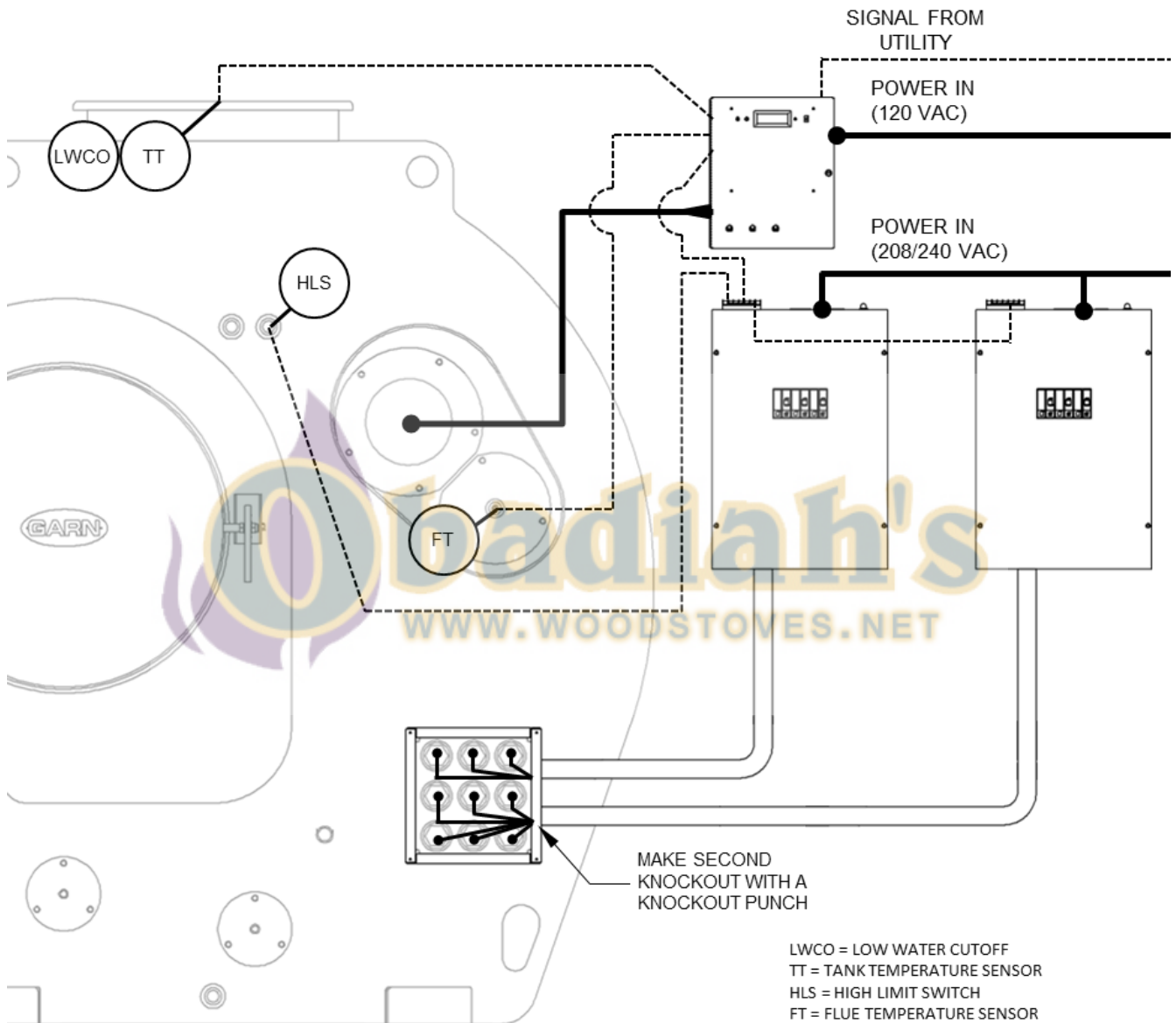
SEQUENCER

Mount the sequencer in close proximity to the digital controller and electric element box. Follow best practices for wiring and mounting the boxes. The intent of the following schematic is to give a general overview of the wiring involved. Refer to the [Wiring Diagrams](#) section of this manual. All wiring should be performed by a licensed electrician.



DUAL SEQUENCERS

When connecting the 49.5 kW electric heating package, two sequencers are required. A metal conduit must be run from each sequencer to the electric element box. If needed, additional knockouts can be made into the electric element box using a knockout punch.



E. OPERATION:

WOOD OR ELECTRIC/WOOD OPERATION



The picture to the left shows the front face of the GARN WHS/ETS digital controller and the location of the controller ON/OFF toggle switch and the WOOD/ELECTRIC toggle switch.



ELECTRIC MODE: Unit may be fired with wood, but it will also use electric for heating if available. If off-peak heating is available it will heat the unit according to the dial switch set point.

WOOD MODE: Unit must be fired with wood. The electric heating elements are disabled.

The digital controller can operate in **Wood** mode and **Electric/Wood** mode. In the Wood mode, the controller allows the operator to fire the GARN unit with wood and will NOT turn the electric elements on to regulate the tank temperature. In the Electric/Wood mode, the operator can still fire the GARN unit with wood, but, in addition, the controller will turn on the electric elements if the following conditions are met:

1. A **utility signal** tells the controller that electricity is available

AND

2. The tank temperature is below the **setpoint** temperature

TEMPERATURE SETPOINT ADJUSTMENT

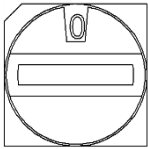
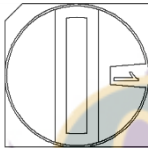
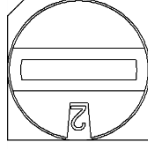
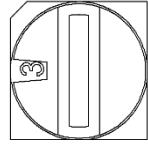
The electric heating function of the GARN® WHS is controlled by the toggle switch on the front of the controller and the **dial switch** (labeled SW-1) on the PC board (see below).



DIAL SWITCH POSITIONS

The dial switch controls the setpoint temperature of the Electric Heating Package. The dial switch may be rotated clockwise or counter-clockwise to set switch to the desired position. Set the dial switch to one of its four possible positions by hand, or by using a small blade screwdriver.

The table below lists the position number and the function corresponding to that position.

Dial Switch Position		Function
Number	Visual Representation (SW-1)	
0		<u>Not Used (Disabled)</u> : A setting of 0 means that the electric heating will not turn on. The controller will function the same as setting the toggle switch on the front of the controller to “WOOD” mode.
1		<u>Outdoor Reset Mode</u> : Targets a tank temperature based on the Outdoor Reset Curve (see Outdoor Reset Curve section of this manual). The electric elements will turn on if off-peak is available and the tank is below the target set point of the outdoor reset curve.
2		<u>Freeze Protection Mode (50°F)</u>: Targets a tank temperature of 50°F. Temperature differential (deadband) = 5°F. If off-peak is available, the electrical elements will turn on if the tank is 45°F or below and remain on until the tank reaches 50°F. NOTICE The elements will not turn on unless off-peak is available. It is recommended that if the tank operates in freeze protection mode, that the unit and piping directly connected to the unit be constantly circulated to prevent piping outside of the tank from freezing (if the unit is located in a generally unheated space). Because the tank has a large volume, there is no danger of freezing the tank even with a 16 hour or more carry-over between periods of electric availability.
3		<u>Maximum Heat Mode (190°F)</u> : Targets a tank temperature of 190°F. Temperature differential (deadband) = 5°F. If off-peak is available, the electrical elements will turn on if the tank is 185°F or below and remain on until the tank reaches 190°F.

OUTDOOR RESET CURVE (USED WITH DIAL POSITION 1)

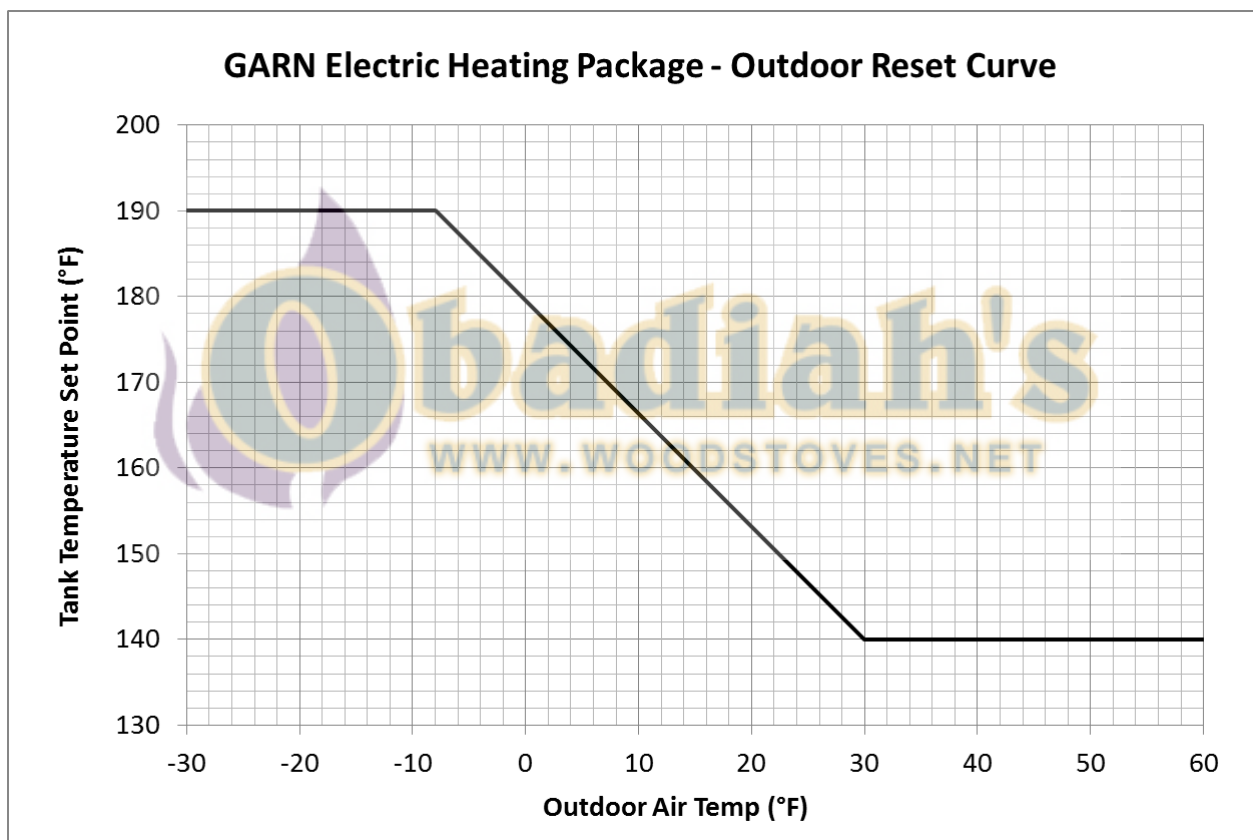
The outdoor reset curve below shows what the tank temperature target setpoint is based on the Outdoor Air Temperature sensor. The controller will only apply this curve if the dial switch is set to Position 1. For the controller to operate properly at Position 1, the outdoor air temperature sensor must be working correctly. If the outdoor air temperature sensor is not operating correctly, then the controller will default to targeting 190°F.

NOTICE

IF THE OUTDOOR AIR TEMPERATURE SENSOR IS NOT OPERATING CORRECTLY, THEN THE CONTROLLER WILL DEFAULT TO TARGETING 190°F.

NOTICE

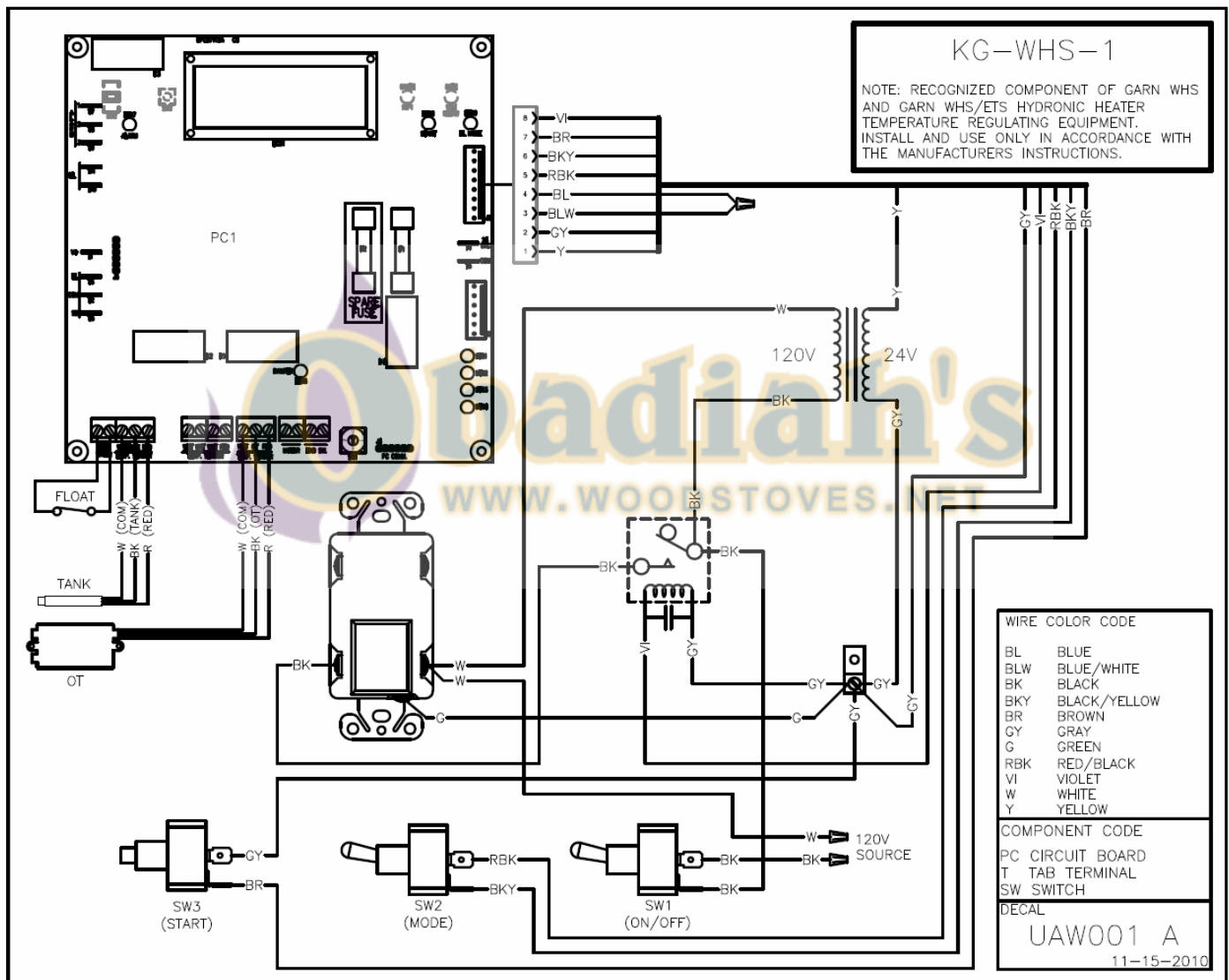
If a different Outdoor Reset Curve is desired for your particular application, a custom chip can be ordered from GARN for a fee.



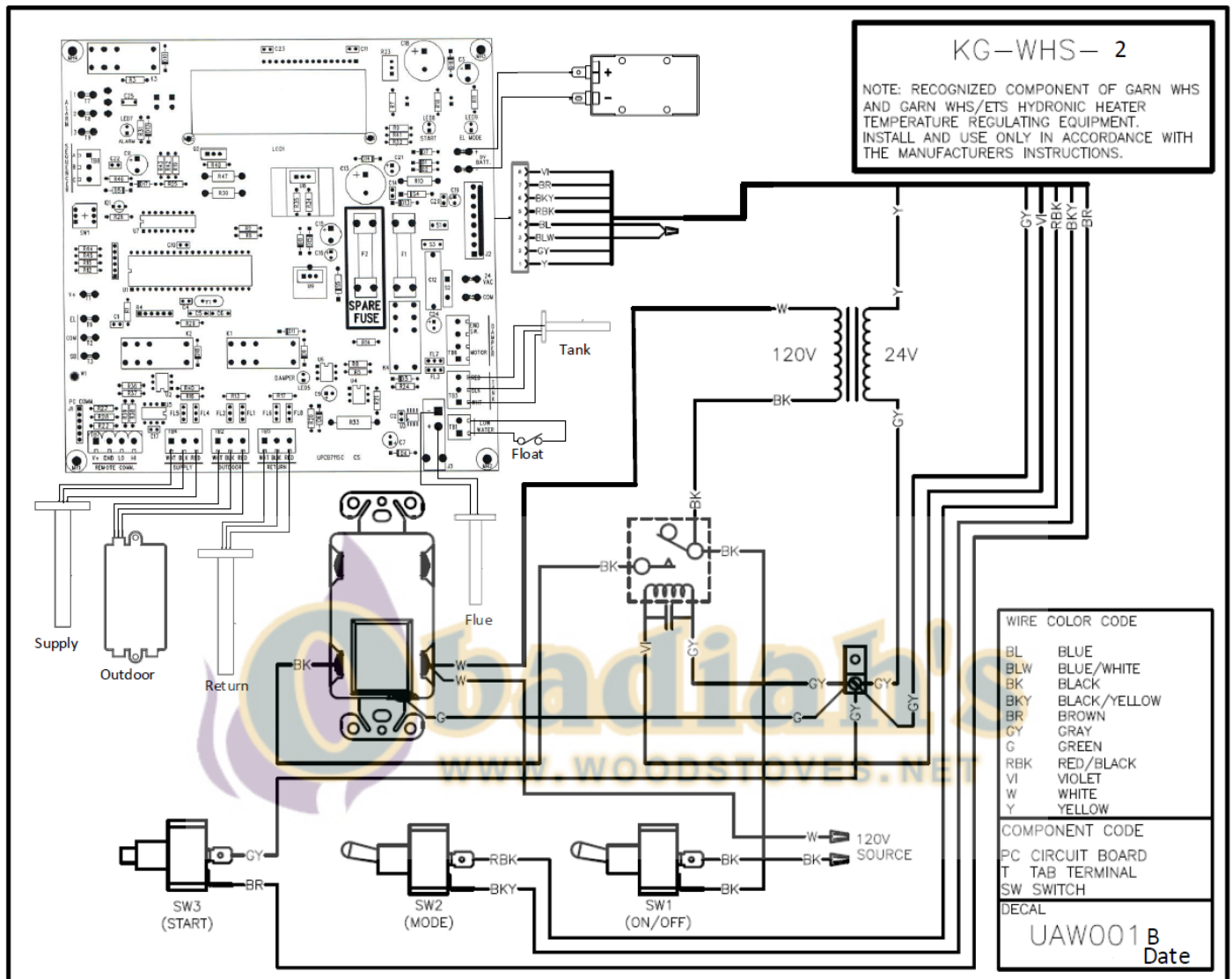
F. WIRING DIAGRAMS:

The diagrams in this section are intended to apply to the newest revision of the Electric Heating Package controls and components. For retrofit applications, or when using controls and components that are used, purchased second-hand, or known not to be of the newest revisions, consult the wiring diagrams and labels located inside the cover of the Sequencer and Electric Element Box. Follow the diagrams and directions provided on the labels with your equipment first before consulting the diagrams found here.

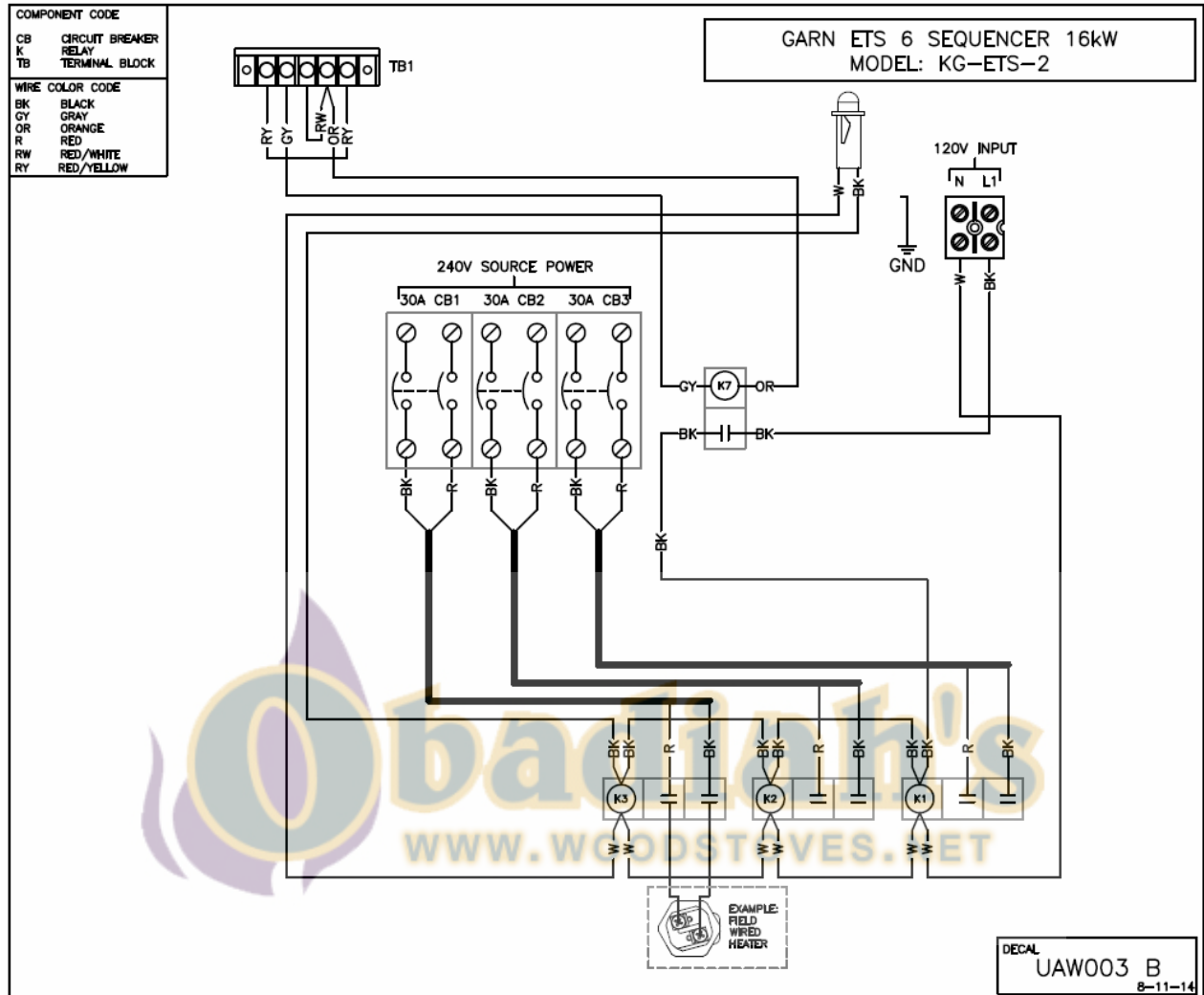
WHS/ETS DIGITAL CONTROLLER - REV A



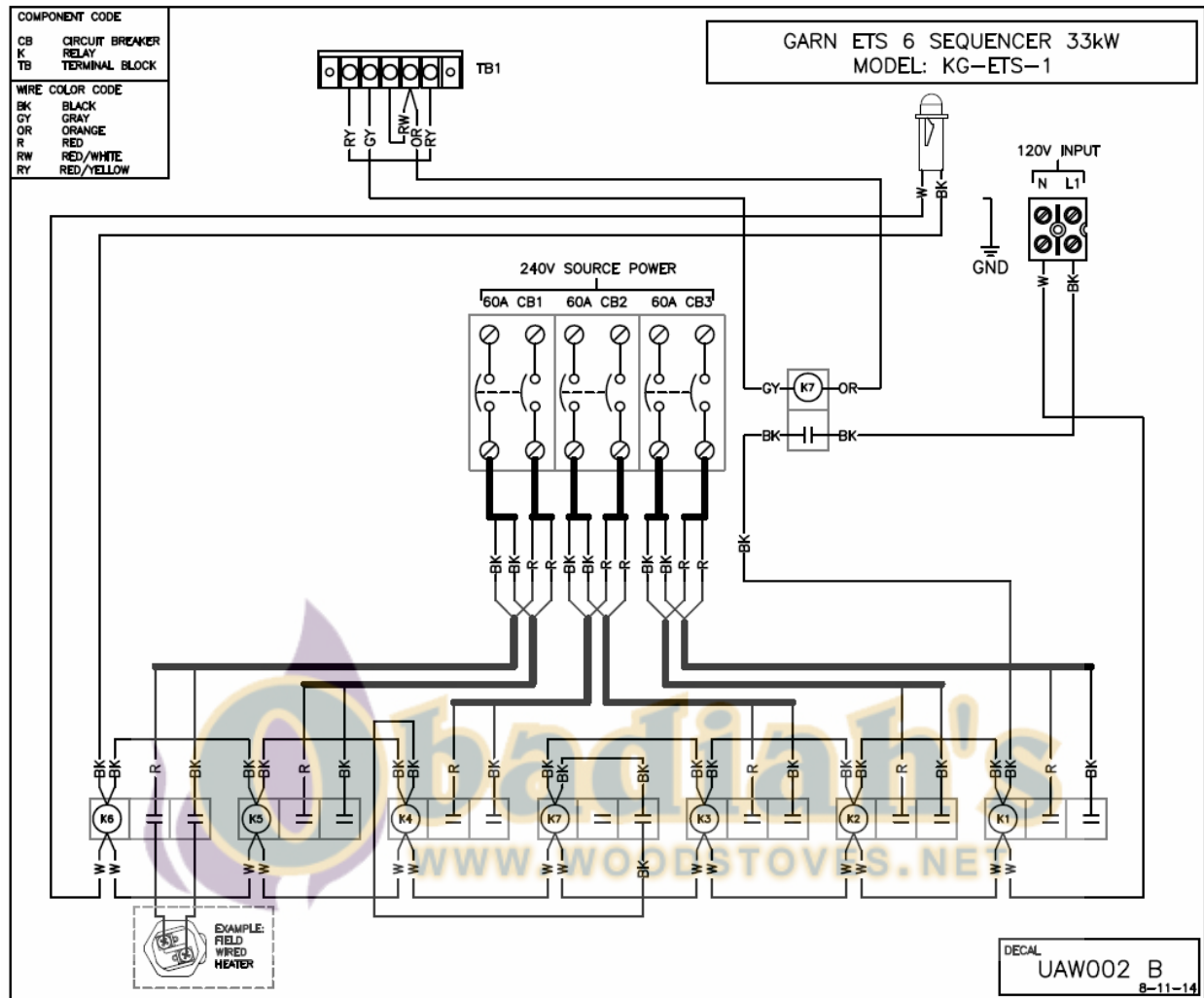
WHS/ETS DIGITAL CONTROLLER - REV C



SEQUENCER - 16.5 KW

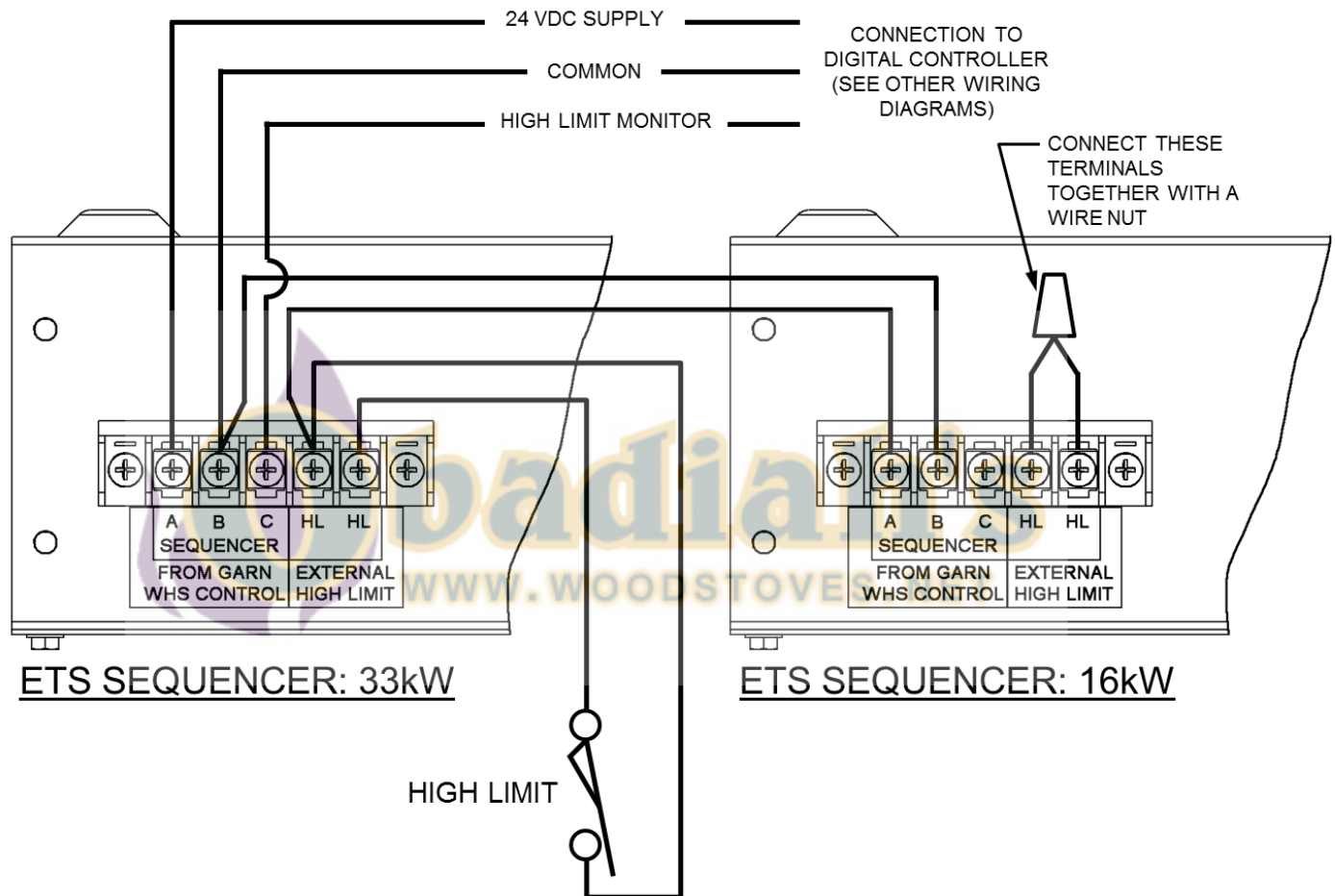


SEQUENCER – 33.0 KW



SEQUENCER – 49.5 KW

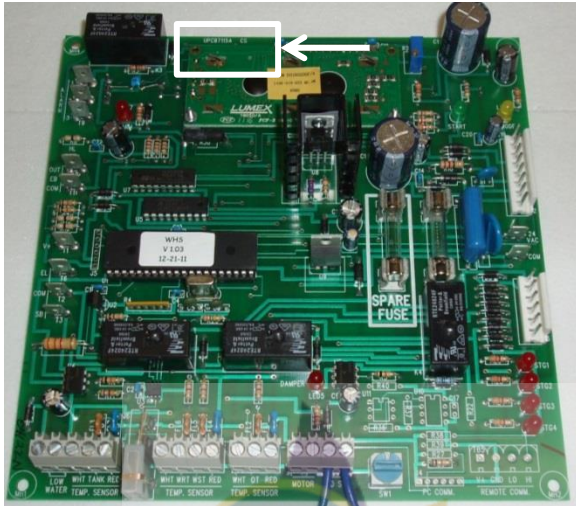
The 49.5 kW heating package is made up of a 33 kW sequencer and 16.5 kW sequencer. Follow the wiring diagrams for each individual sequencer from the previous sections. After the elements and high voltage wiring is complete, the two sequencers must then be wired to work together as shown below. The signal from the digital controller is wired to one sequencer which relays the signal to the second sequencer. The sequencers are essentially wired in parallel so both sequencers are activated at the same time when the controller calls for heat. A single high limit switch protects both sequencers.



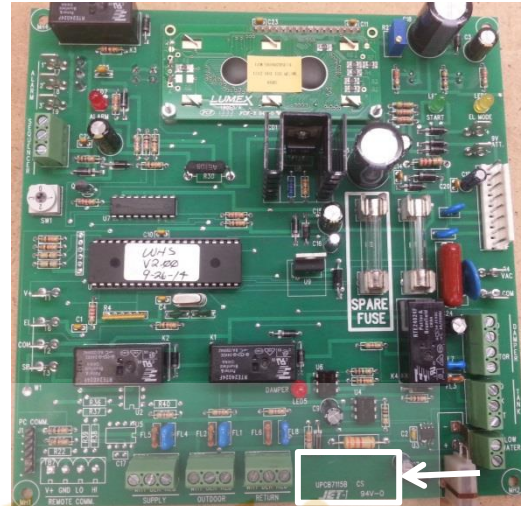
IDENTIFYING YOUR BOARD REVISION

Your board revision will determine how the controller will interface with the sequencer. The identification for your board is located in one of two spots. The board number begins with “UPC7115” followed by the letters A or C. The letter indicates the revision of the board.

Revision UPC7115A has the label located here:

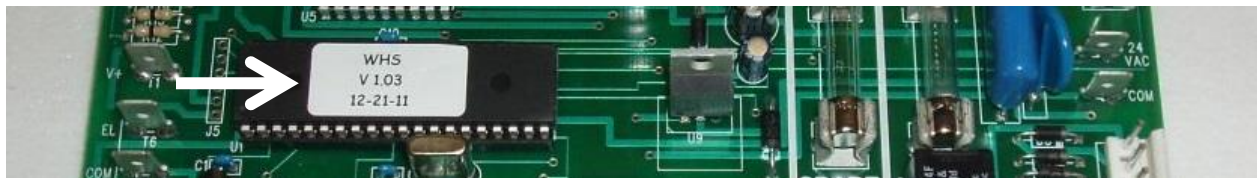


Revision UPC7115C has the label located here:



IDENTIFYING YOUR CHIP REVISION

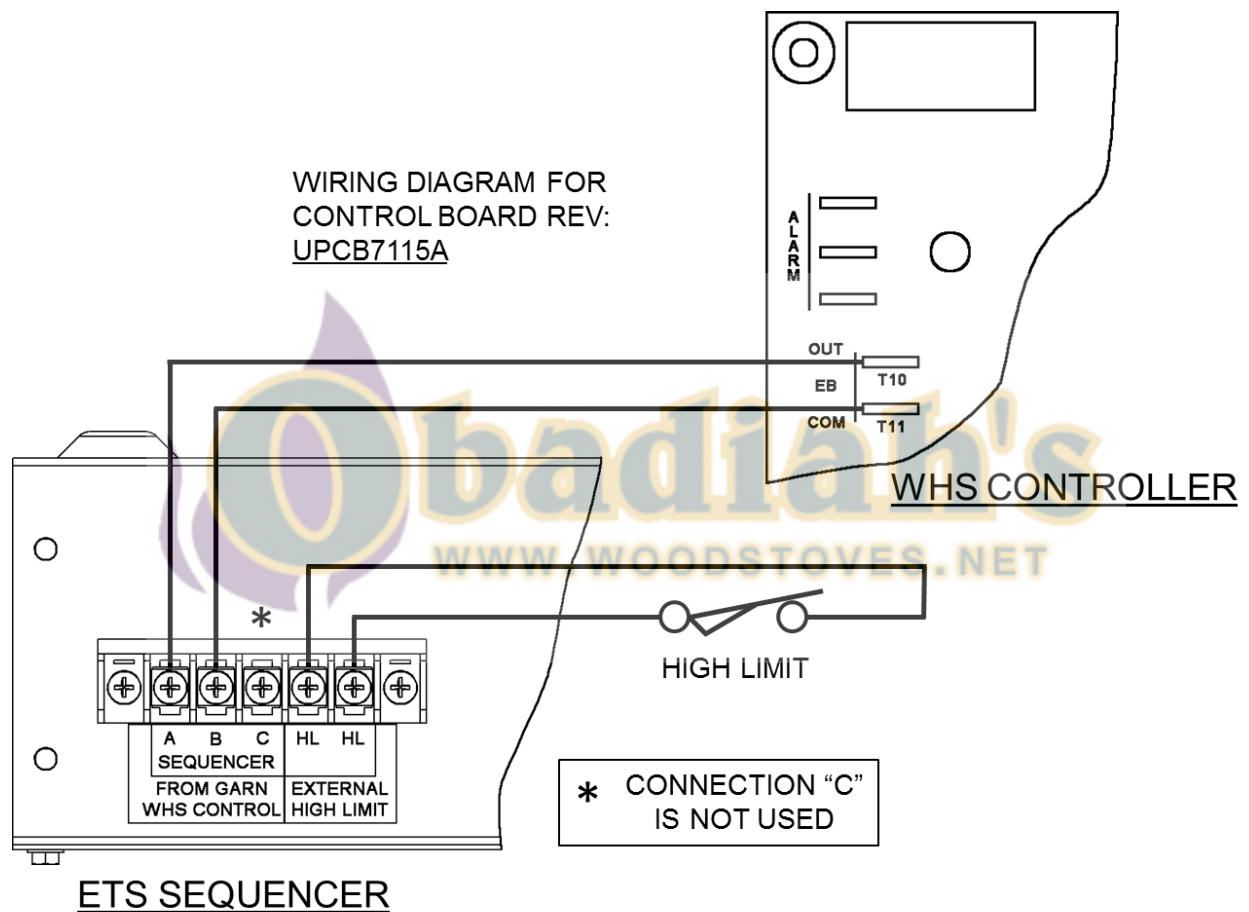
The digital controller has the feature of being upgradeable. The latest version of the chip is supplied with the purchase of the electric heating package. However, for reference, to identify the version of chip that is installed in your board, read the label adhered to the chip:



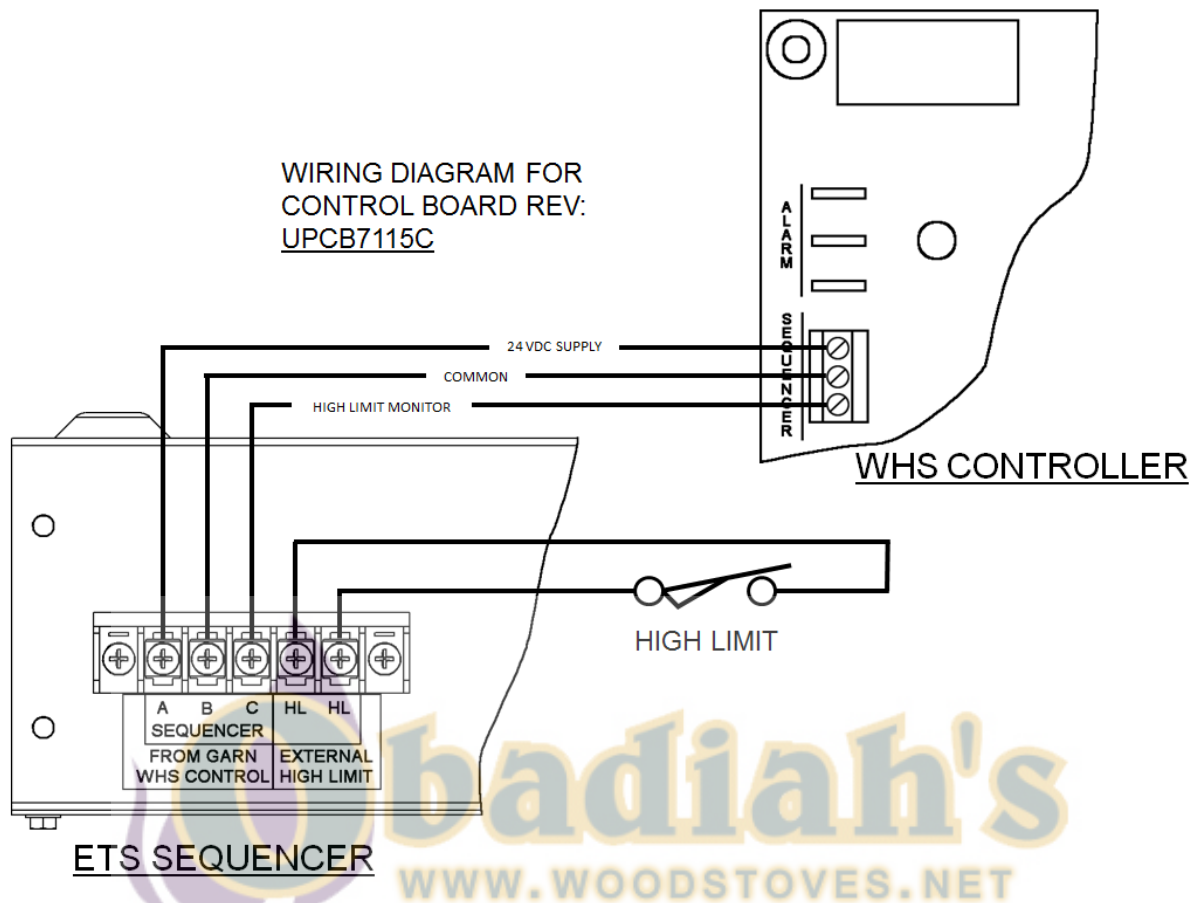
CONTROLLER TO SEQUENCER WIRING – BOARD REV: UPC7115-A

Wiring to the GARN WHS controller with a UPC7115A board requires a chip with version V1.21 or greater. The latest version of the chip is supplied with the purchase of the electric heating package, but if the equipment has been acquired second-hand (used), it is prudent to check the version to make sure the heating package will function correctly. Check the chip version number by looking at the label applied to the chip.

Two (2) conductors are wired from the OUT and COM connections on the board (terminals T10 and T11) to the A and B terminals, respectively, on the sequencer. The C terminal on the sequencer is unused.



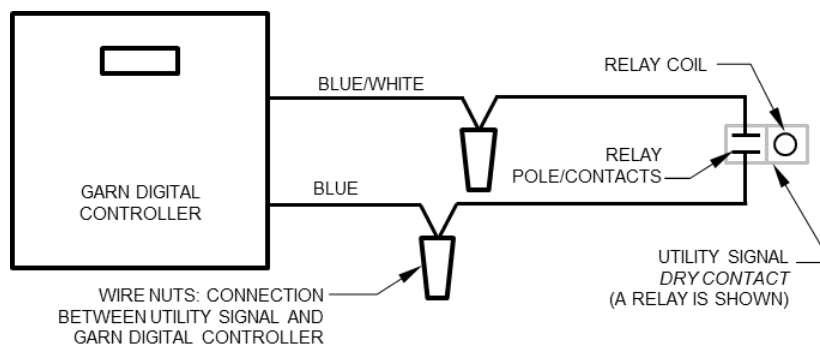
CONTROLLER TO SEQUENCER WIRING – BOARD REV: UPC7115-C



The Rev C board has three (3) wires between the controller and the sequencer. The third wire (Connection C) is the “High Limit Monitor”. The High Limit Monitor sends a feedback signal to the controller to tell the controller if the high limit is wired and working correctly. If the high limit is not wired or operating properly, a sensor error will appear on the LCD display of the controller.

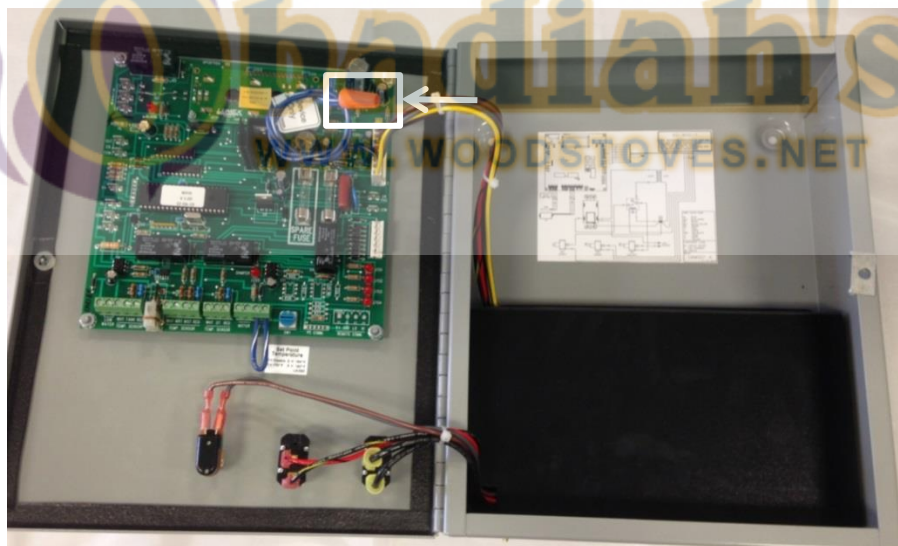
CONTROLLER TO OFF-PEAK METER WIRING

The controller requires an input signal from the utility/coop that lets the controller know when off-peak electricity is available. This is accomplished through a *dry contact* provided by the utility/coop. A *dry contact* is a circuit that does not impose any current or voltage on the switched circuit. Typically a dry contact is just a pair of contacts on a relay with no current or voltage source connected. For example:



THE CONNECTION WITH THE UTILITY MUST BE A DRY CONTACT (NOT A VOLTAGE OR CURRENT SOURCE) OTHERWISE DAMAGE TO THE CONTROLLER MAY RESULT.

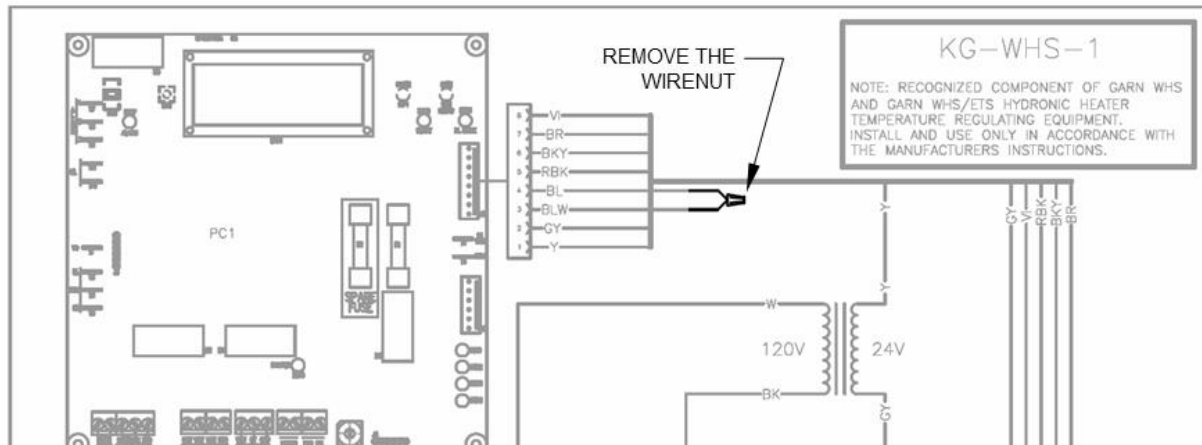
- 1.) Locate the pair of BLUE/BLEU-WHITE wires connected together at the factory with a wire nut.



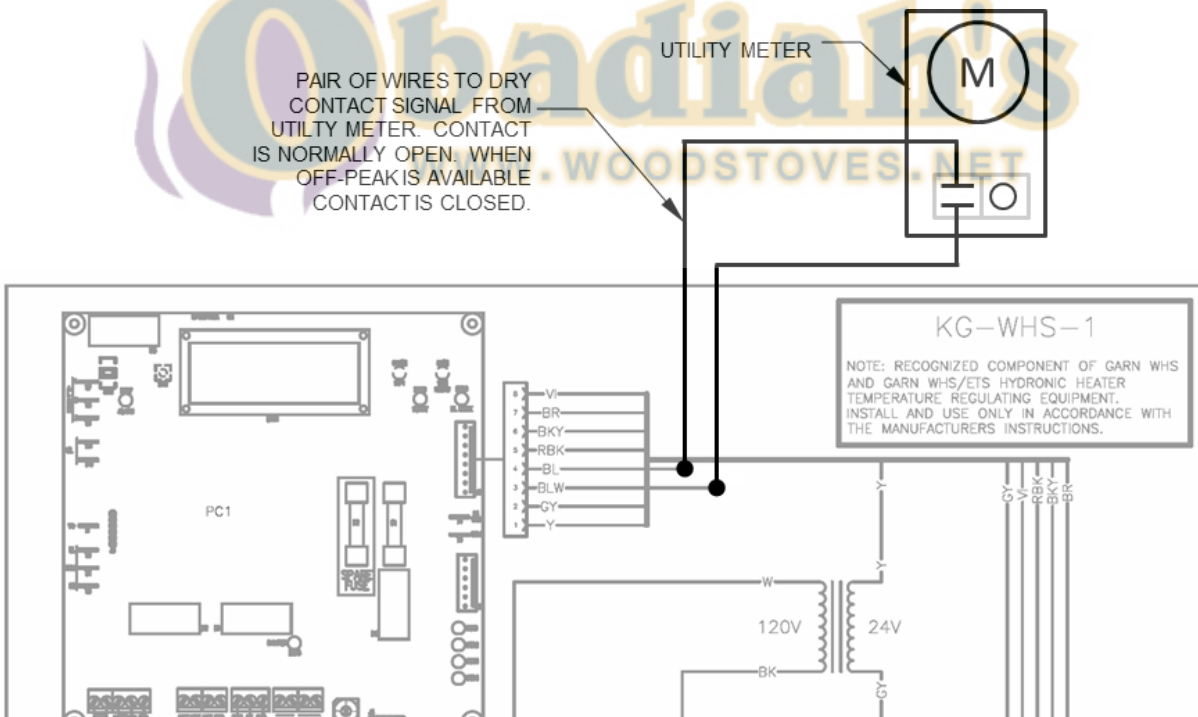
- 2.) Remove the wire nut and connect the pair of conductors to either side of the contact provided by the utility.
- 3.) The controller will now turn on the elements only if the utility sends a signal that off-peak is available and the tank is below the setpoint temperature.
- 4.) If you ever want to override the utility's signal control, reinstall the wire nut on the BLUE/BLEU-WHITE wire pair. Doing so essentially indicates to the controller that off-peak is always available.

Schematically, the removal of the wire nut and connection to a dry contact is as follows:

- 1.) Remove the wire nut from the BLUE/BLUE-WHITE wire pair.

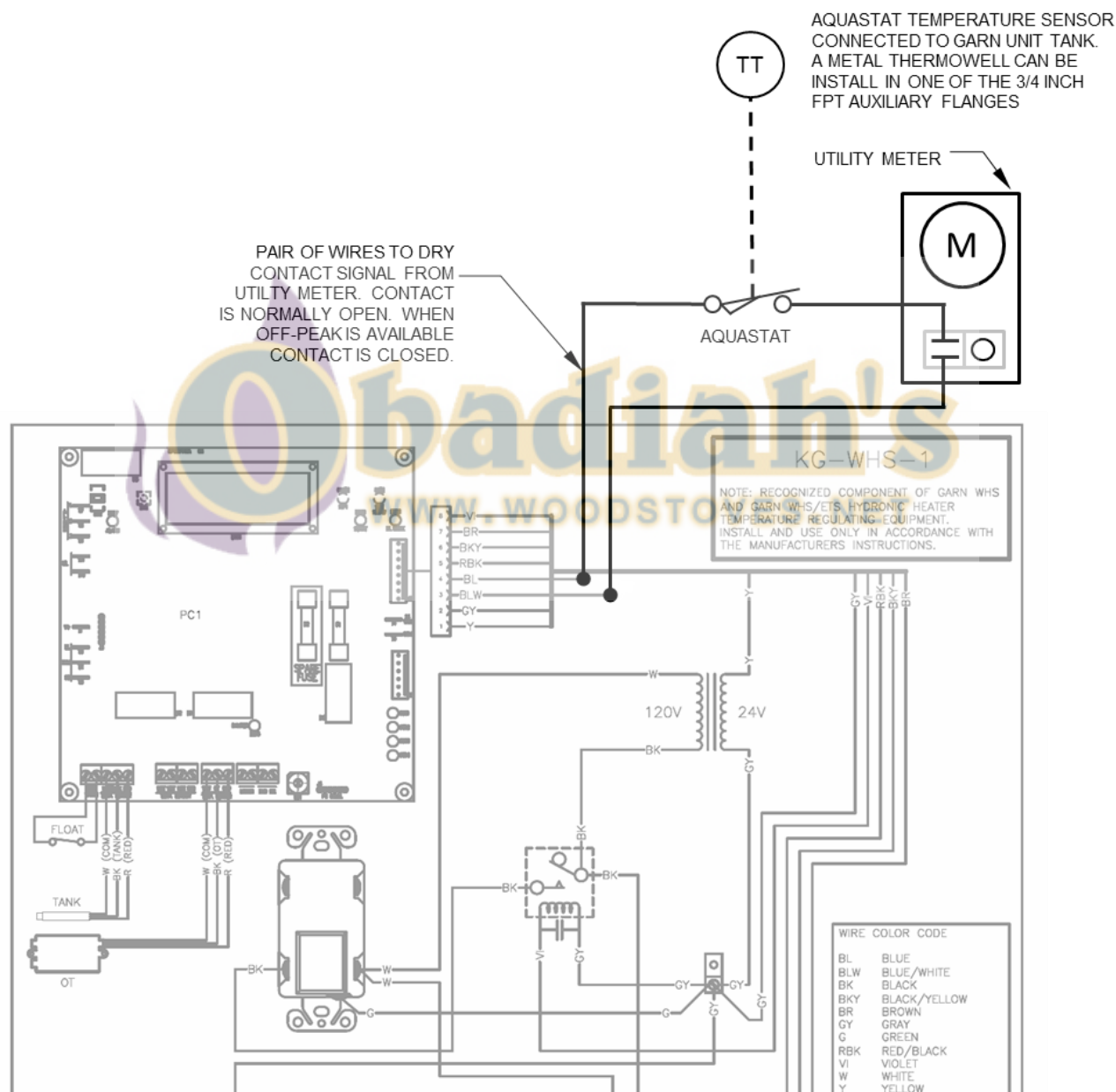


- 2.) Connect the BLUE/BLUE-WHITE wire pair to either side of a dry contact provided by the utility. The contact is closed when off-peak is available and open when off-peak is not available.



USING AN AQUASTAT TO SET A CUSTOM DEADBAND AND SETPOINT

The digital controller comes pre-programmed with a non-adjustable 5°F deadband for all of its setpoints. For example, if a dial switch position of 3 is chosen (setpoint temperature of 190°F), and off-peak electricity is available, then the elements will turn on when the tank is at or below 185°F. The elements will remain on until the tank reaches its setpoint of 190°F. The elements will then turn off. When the tank drops back down to 185°F, the cycle repeats. If you wish to set a customizable deadband and setpoint, wiring an aquastat in series with the existing controls is a simple and cost effective way to do so. Choose the aquastat for your application and wire as the diagram shows below.



NOTE: Alternatively, the aquastat can be wired in series with the signal wire from the controller to the sequencer.

G. WARRANTY

GARN® products are warranted by the manufacturer to be free of defects in material and workmanship as follows, with the below-enumerated exclusions:

- With respect to the controls and miscellaneous parts furnished as part of the basic unit, a one-year warranty shall apply.
- With respect to the sequencer and electric element box, a five-year warranty shall apply with regard to materials and workmanship.
- With respect to wear items such as gaskets, electric elements, o-rings, etc., a one-year warranty shall apply regarding materials and workmanship excluding normal wear and tear. Proper use and periodic maintenance will extend the life of these items.
- NO WARRANTY SHALL APPLY WITH REGARD TO EPOXY COATINGS, PAINT, CORROSION OR CORROSION INDUCED FAILURES OF ANY COMPONENT OF THE UNIT OR COMPONENTS ATTACHED TO THE UNIT. It is the sole responsibility of the owner to install, maintain and test water treatment chemicals in order to minimize corrosion potential and damage. Testing of the GARN® water is required twice every year. A record of this compliance is required or warranty is VOID.
- THIS WARRANTY IS EXPRESSLY MADE IN LIEU OF ANY & ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED. NO WARRANTY OF MERCHANTABILITY OR OF FITNESS FOR PURPOSE SHALL APPLY. NO WARRANTY OF LOCAL CODE ACCEPTANCE OR OF INSURANCE CARRIER ACCEPTANCE SHALL APPLY. NO WARRANTY FOR INSTALLATION OR FOR HEATING SYSTEM PARTS OR PERFORMANCE SHALL APPLY.

