# CARAVAN

# HOT WATER/GAS
# APPLICATION GUIDE

**Guidelines for the design, purchase and installation of Slant/Fin Caravan gas-fired, hot water modular boiler systems.**

## CONTENTS



* All wiring diagrams are based on continuous circulation.

### CODES AND STANDARDS

All Caravan installations must comply to local codes or, in the absence of local codes, to the National Fuel Gas Code, ANSI, Z223.1-latest edition.

In addition where required by the authority having jurisdiction, the installation must conform to American Society of Mechanical Engineers Safety Codes for controls and safety devices for automatically fired boilers, No. CSD-1. The installation must also conform to the additional requirements of Slant/Fin Instruction Book publication no. GG-100-40 latest edition.

All electrical wiring is to be done in accordance with the National Electrical Code ANSI/NFPA No. 70-latest edition and all local electrical codes. The unit must be electrically grounded if an external power source is used.

In Canada, the installation must be in accordance with standards CGA B149.1 and B149.2, installation codes for gas burning appliances and equipment and/or local codes. All electrical connections are to be made in accordance with Standard C.S.A. C22.1 Canadian Electrical Code Part 1 and/or local codes.

Many state and local codes require intermittent ignition devices for gas boilers. Please specify if necessary.

### INTRODUCTION OF FRESH WATER

Introduction of excessive amounts of fresh water into a system can cause scaling and leave deposits in the boiler and the surrounding pipes. This will lead to inefficient boiler operation and breakdown. Fresh water will enter the system as a result of hidden leaks such as may occur in underground piping. Relief valves should be piped to a location that shows visible signs of relief.

Process applications that use fresh water, require the use of heat exchangers. Any process application that results in introduction of fresh water into a boiler can cause scaling with deposits forming in the boiler and surrounding piping. This will damage the boiler. Introduction of fresh water from leaks will cause similar damage.

In some areas it may be necessary to use a feed water treatment to control the corrosive makeup of the feed water. Check with the local authority, to determine if the feed water will need a conditioning treatment before being supplied to the boiler.

## INTRODUCTION

This Caravan application manual is intended to simplify the selection and application of Slant/Fin modular systems for a variety of space heating and domestic hot water requirements. It applies to gas-fired, hot water applications only. Where intermittent pilot, vent damper or any additional information is required, contact your local wholesaler, Slant/Fin sales representative, or the Slant/Fin factory.

Due to design flexibility of a Caravan modular boiler system, BTU input capacities are unlimited.

**A. Boiler room design, size and flexibility** - since Caravan modules have the burner and controls mounted to the front, they can be installed with minimum clearances as per codes, thus saving a significant amount of floor space.

**B. Faster, easier installation** - modules are completely factory assembled, including individual jackets to save on-site labor. Optional easy to install return and supply headers with flexible quick connect fittings are available for hot water systems.

**C. Safety** - each module contains an individual high limit control and a dual combination gas valve. ASME relief valve is provided separately for mounting directly on each module.

**D. Fast domestic hot water recovery** - Caravan offers an external heat exchanger of the positive circulating type.

Slant/Fin®


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***Table 1: Gas Caravan ratings and dimension/hot water model—GGT Series (100 PSI maximum working pressure)***

| Model No. | Consists of | | I=B=R Ratings (MBH) | | EDR Water‡ (Sq.Ft.) | I=B=R Net Output† | Boiler Horse-power | Water Content (gal.) | Ship Wt. | Jkt. Width A§ | Draft Hood Ht. B§ | Flue Collar C§ | Draft Hood Ht. D§ | Header to Header E§ | Space Btwn. Mods. F§ | Length with Header L§ | Min. Header Size‡ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | No.of Htg. Mod. | Module Model Number | Input | Gross Output | | | | | | | | | | | | | |
| GGT-400E | 2 | GG-200EC | 400 | 332 | 1866 | 280 | 9.9 | 14.2 | 820 | 19 15/16 | 57 1/2 | 7 | 8 31/32 | 15 1/16 | 12 1/16 | 4'4" | 2" |
| GGT-500E | 2 | GG-250EC | 500 | 402 | 2333 | 350 | 12.0 | 16.4 | 950 | 23 5/16 | 59 3/8 | 8 | 10 11/32 | 18 7/16 | 8 1/16 | 4'8" | 2" |
| GGT-600E | 2 | GG-300EC | 600 | 480 | 2780 | 417 | 14.3 | 18.4 | 1080 | 26 11/16 | 59 3/8 | 8 | 12 1/32 | 21 13/16 | 5 5/16 | 4'11" | 2" |
| GGHT-700E | 2 | GG-350HEC | 700 | 581 | 3368 | 505 | 17.3 | 20.6 | 1230 | 30 1/16 | 67 1/8 | 9 | 13 23/32 | 25 1/16 | 1 15/16 | 5'2" | 2" |
| GGHT-750E | 2 | GG-375HEC | 750 | 608 | 3520 | 529 | 18.1 | 20.6 | 1230 | 30 1/16 | 59 3/8 | 10 | 13 23/32 | 25 1/16 | 1 15/16 | 5'2" | 2" |
| GGHT-800E | 2 | GG-399HEC | 798 | 654 | 3786 | 569 | 19.5 | 20.6 | 1230 | 30 1/16 | 62 5/8 | 10 | 13 23/32 | 25 1/16 | 1 15/16 | 5'2" | 2" |
| GGT-900E | 3 | GG-300EC | 900 | 720 | 4173 | 626 | 21.5 | 27.6 | 1590 | 26 11/16 | 59 3/8 | 8 | 12 1/32 | 21 13/16 | 5 5/16 | 7'7" | 2" |
| GGHT-1050E | 3 | GG-350HEC | 1050 | 872 | 5052 | 758 | 26 | 30.9 | 1830 | 30 1/16 | 67 1/8 | 9 | 13 23/32 | 25 1/16 | 1 15/16 | 7'10" | 2" |
| GGHT-1125E | 3 | GG-375HEC | 1125 | 912 | 5286 | 793 | 27.2 | 30.9 | 1830 | 30 1/16 | 59 3/8 | 10 | 13 23/32 | 25 1/16 | 1 15/16 | 7'10" | 2" |
| GGHT-1200E | 3 | GG-399HEC | 1197 | 981 | 5686 | 853 | 29.3 | 30.9 | 1830 | 30 1/16 | 62 5/8 | 10 | 13 23/32 | 25 1/16 | 1 15/16 | 7'10" | 3" |
| GGT-1200E | 4 | GG-300EC | 1200 | 960 | 5560 | 834 | 28.7 | 36.8 | 2140 | 26 11/16 | 59 3/8 | 8 | 12 1/32 | 21 13/16 | 5 5/16 | 10'3" | 3" |
| GGHT-1400E | 4 | GG-350HEC | 1400 | 1162 | 6736 | 1010 | 34.7 | 41.2 | 2440 | 30 1/16 | 67 1/8 | 9 | 13 23/32 | 25 1/16 | 1 15/16 | 10'6" | 3" |
| GGHT-1500E | 4 | GG-375HEC | 1500 | 1216 | 7046 | 1057 | 36.3 | 41.2 | 2440 | 30 1/16 | 59 3/8 | 10 | 13 23/32 | 25 1/16 | 1 15/16 | 10'6" | 3" |
| GGT-1500E | 5 | GG-300EC | 1500 | 1200 | 6950 | 1043 | 35.9 | 46.0 | 2675 | 26 11/16 | 59 3/8 | 8 | 12 1/32 | 21 13/16 | 5 5/16 | 12'11" | 3" |
| GGHT-1600E | 4 | GG-399HEC | 1596 | 1308 | 7580 | 1137 | 39.0 | 41.2 | 2440 | 30 1/16 | 62 5/8 | 10 | 13 23/32 | 25 1/16 | 1 15/16 | 10'6" | 3" |
| GGHT-1750E | 5 | GG-350HEC | 1750 | 1453 | 8420 | 1263 | 43.4 | 51.5 | 3050 | 30 1/16 | 67 1/8 | 9 | 13 23/32 | 25 1/16 | 1 15/16 | 13'2" | 3" |
| GGHT-1875E | 5 | GG-375HEC | 1875 | 1520 | 8806 | 1321 | 45.4 | 51.5 | 3050 | 30 1/16 | 59 3/8 | 10 | 13 23/32 | 25 1/16 | 1 15/16 | 13'2" | 3" |
| GGHT-2000E | 5 | GG-399HEC | 1995 | 1635 | 9473 | 1421 | 48.8 | 51.5 | 3050 | 30 1/16 | 62 5/8 | 10 | 13 23/32 | 25 1/16 | 1 15/16 | 13'2" | 3" |
| GGHT-2100E | 6 | GG-350HEC | 2100 | 1743 | 10104 | 1516 | 52 | 61.8 | 3660 | 30 1/16 | 67 1/8 | 9 | 13 23/32 | 25 1/16 | 1 15/16 | 15'10" | 3" |
| GGHT-2250E | 6 | GG-375HEC | 2250 | 1824 | 10573 | 1586 | 54.4 | 61.8 | 3660 | 30 1/16 | 59 3/8 | 10 | 13 23/32 | 25 1/16 | 1 15/16 | 15'10" | 3" |
| GGHT-2400E | 6 | GG-399HEC | 2394 | 1962 | 11373 | 1706 | 58.6 | 61.8 | 3660 | 30 1/16 | 62 5/8 | 10 | 13 23/32 | 25 1/16 | 1 15/16 | 15'10" | 3" |
| GGHT-2450E | 7 | GG-350HEC | 2450 | 2034 | 11788 | 1768 | 60.7 | 72.1 | 4270 | 30 1/16 | 67 1/8 | 9 | 13 23/32 | 25 1/16 | 1 15/16 | 15'10" | 3" |
| GGHT-2625E | 7 | GG-375HEC | 2625 | 2128 | 12333 | 1850 | 63.5 | 72.1 | 4270 | 30 1/16 | 59 3/8 | 10 | 13 23/32 | 25 1/16 | 1 15/16 | 18'6" | 3" |
| GGHT-2800E | 7 | GG-399HEC | 2793 | 2289 | 13266 | 1990 | 68.3 | 72.1 | 4270 | 30 1/16 | 62 5/8 | 10 | 13 23/32 | 25 1/16 | 1 15/16 | 18'6" | 3" |
| GGHT-2800E | 8 | GG-350HEC | 2800 | 2324 | 13472 | 2021 | 69.4 | 82.4 | 4880 | 30 1/16 | 67 1/8 | 9 | 13 23/32 | 25 1/16 | 1 15/16 | 21'2" | 3" |
| GGHT-3000E | 8 | GG-375HEC | 3000 | 2432 | 14093 | 2115 | 72.6 | 82.4 | 4880 | 30 1/16 | 59 3/8 | 10 | 13 23/32 | 25 1/16 | 1 15/16 | 21'2" | 3" |
| GGHT-3150E | 9 | GG-350HEC | 3150 | 2615 | 15157 | 2273 | 78.1 | 82.4 | 5490 | 30 1/16 | 67 1/8 | 9 | 13 23/32 | 25 1/16 | 1 15/16 | 23'10" | 3" |
| GGHT-3200E | 8 | GG-399HEC | 3192 | 2616 | 15160 | 2275 | 78.1 | 82.4 | 4880 | 30 1/16 | 62 5/8 | 10 | 13 23/32 | 25 1/16 | 1 15/16 | 21'2" | 3" |
| GGHT-3375E | 9 | GG-375HEC | 3375 | 2736 | 15860 | 2379 | 81.7 | 92.7 | 5490 | 30 1/16 | 59 3/8 | 10 | 13 23/32 | 25 1/16 | 1 15/16 | 23'10" | 3" |
| GGHT-3500E | 10 | GG-350HEC | 3500 | 2905 | 16841 | 2526 | 86.7 | 92.7 | 6100 | 30 1/16 | 67 1/8 | 9 | 13 23/32 | 25 1/16 | 1 15/16 | 26'6" | 3" |
| GGHT-3600E | 9 | GG-399HEC | 3591 | 2943 | 17060 | 2559 | 87.9 | 92.7 | 5490 | 30 1/16 | 62 5/8 | 10 | 13 23/32 | 25 1/16 | 1 15/16 | 23'10" | 3" |
| GGHT-3750E | 10 | GG-375HEC | 3750 | 3040 | 17620 | 2643 | 90.8 | 103.0 | 6100 | 30 1/16 | 59 3/8 | 10 | 13 23/32 | 25 1/16 | 1 15/16 | 26'6" | 3" |
| GGHT-4000E | 10 | GG-399HEC | 3990 | 3270 | 18953 | 2843 | 97.6 | 103.0 | 6100 | 30 1/16 | 62 5/8 | 10 | 13 23/32 | 25 1/16 | 1 15/16 | 26'6" | 3" |

**FOR LARGER SIZES, USE MULTIPLES OF THE ABOVE.**

* Specify gas by name, "Natural" or "Propane".

† Net ratings are based on piping and pick-up allowance of 1.15. Slant/Fin should be consulted before selecting a boiler for installation having unusual piping and/or pick-up requirements. Ratings must be reduced by 4% at 2,000 ft. elevation and an additional 4% for every additional 1,000 ft. elevation over 2,000 ft.

‡ Net ratings in square feet based on emission rate of 150 Btuh/sq. ft.

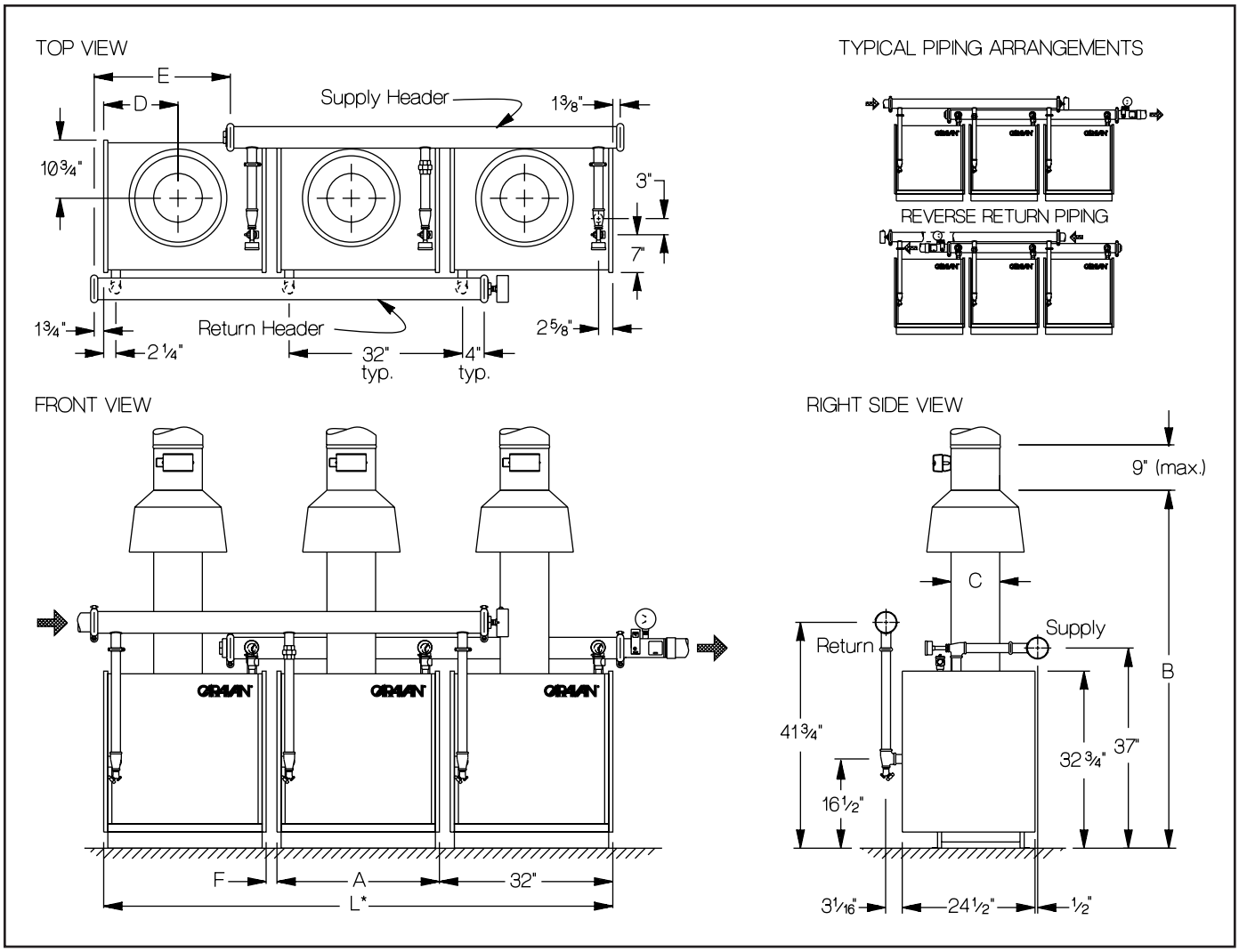
§ Refer to figures 1 and 8. Headers shown are optional.

‡‡All factory supplied headers use 3" system connections.

Modules in excess of 10 should be piped in parallel in two or more batteries.

Note: For higher capacities, specify correct combination of standard Caravan modules shown.

***Figure 1: Gas Caravan dimensions and typical piping/hot water models***




Design Data
Max. ASME Working Pressure: 100 PSI
Power Requirements: 120 volts, 60 HZ, .34 amps per module

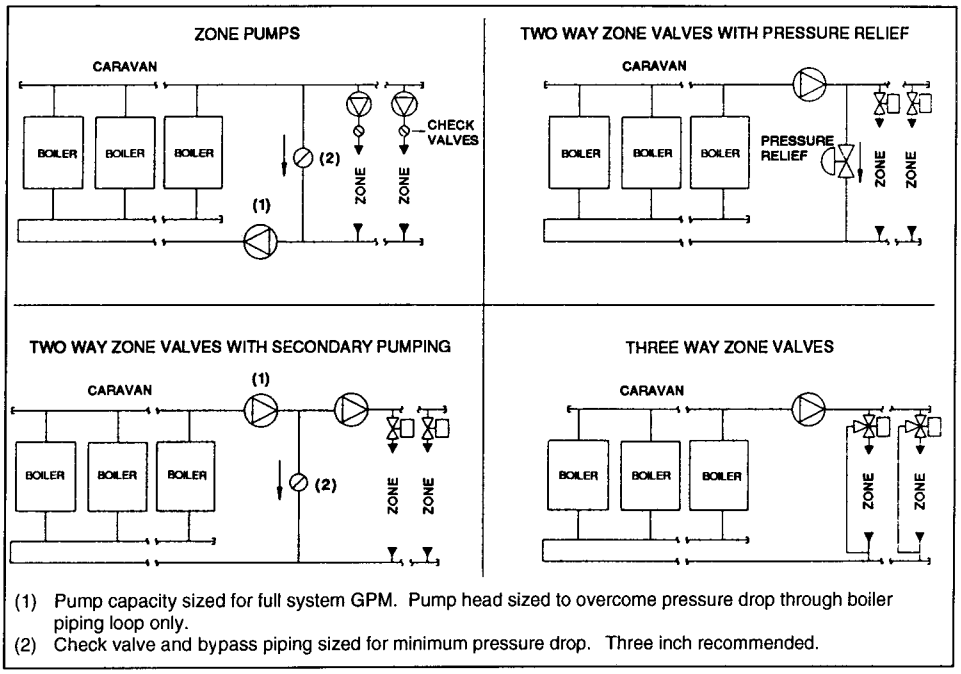



*Figure 2. Recommended boiler piping for variable circulation*

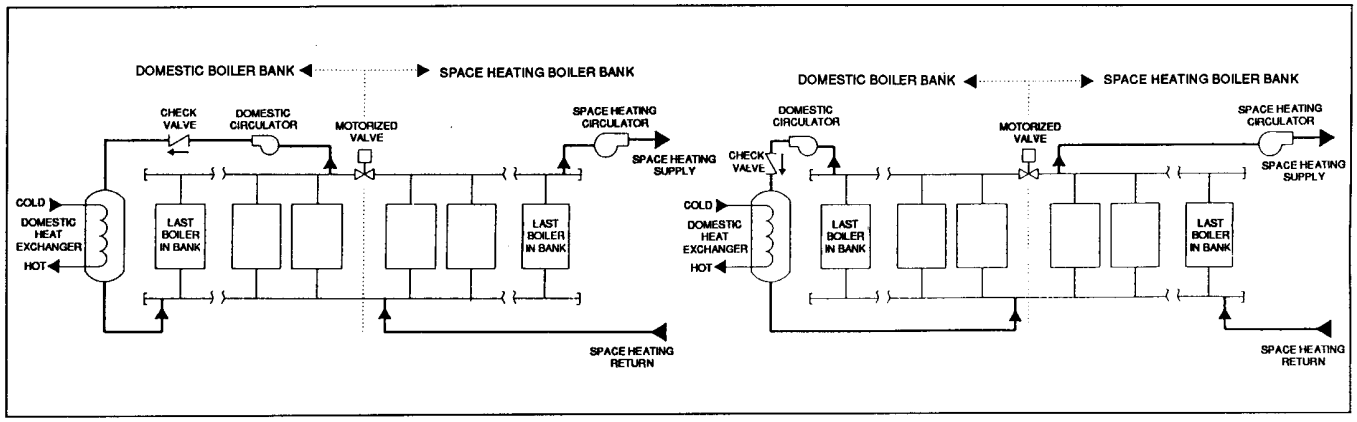



*Figure 3. Supply and return piping locations*

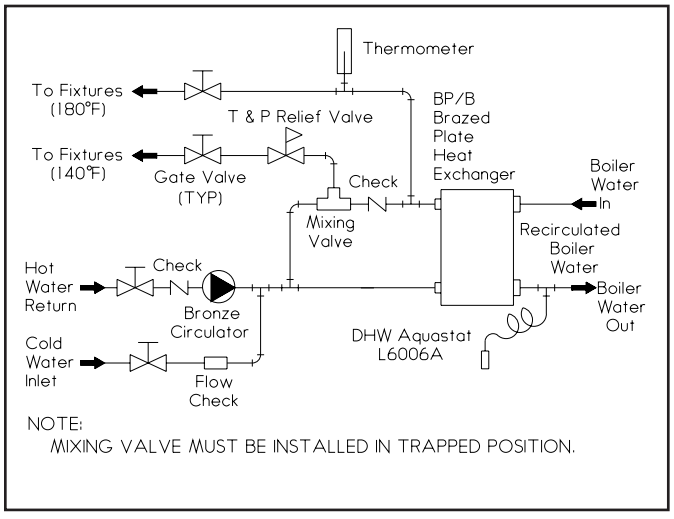



*Figure 4. Instantaneous tankless coil— two temperature with recirculation*

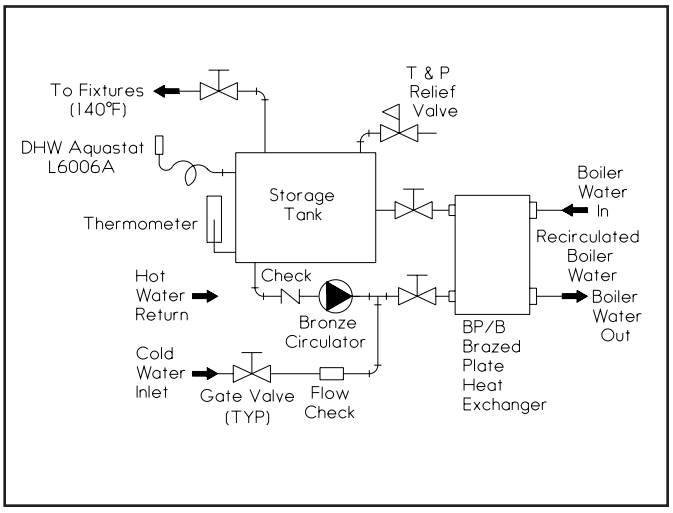



*Figure 5. Storage tank from tankless coil with recirculation*

## EQUIPMENT INCLUDED
## GGT SERIES — Hot Water Models

**One per module unless otherwise noted**

- Pre-assembled heat exchangers with built-in air separators and insulated jacket.
- Base.
- Flue collector.
- Gas burners, gas orifices and manifold assembly.
- Combination gas valve including manual shut-off pressure regulator.
- Pilot adjustment and automatic pilot-thermocouple safety.
- Hi-limit control.
- System pressure and temperature gauge (unmounted, one per system).
- Module pressure and temperature gauge (unmounted).
- Module pressure relief valve (ASME) (unmounted). Specify 30, 50 or 100 PSI.
- Control header (unmounted, one per system).
- Draft hoods (unmounted).

## OPTIONAL EQUIPMENT

- Hot water supply and return header assemblies.
- Control panel with automatic lead lag.
- Spark ignition system.
- Vent dampers.
- External DHW heat exchanger.

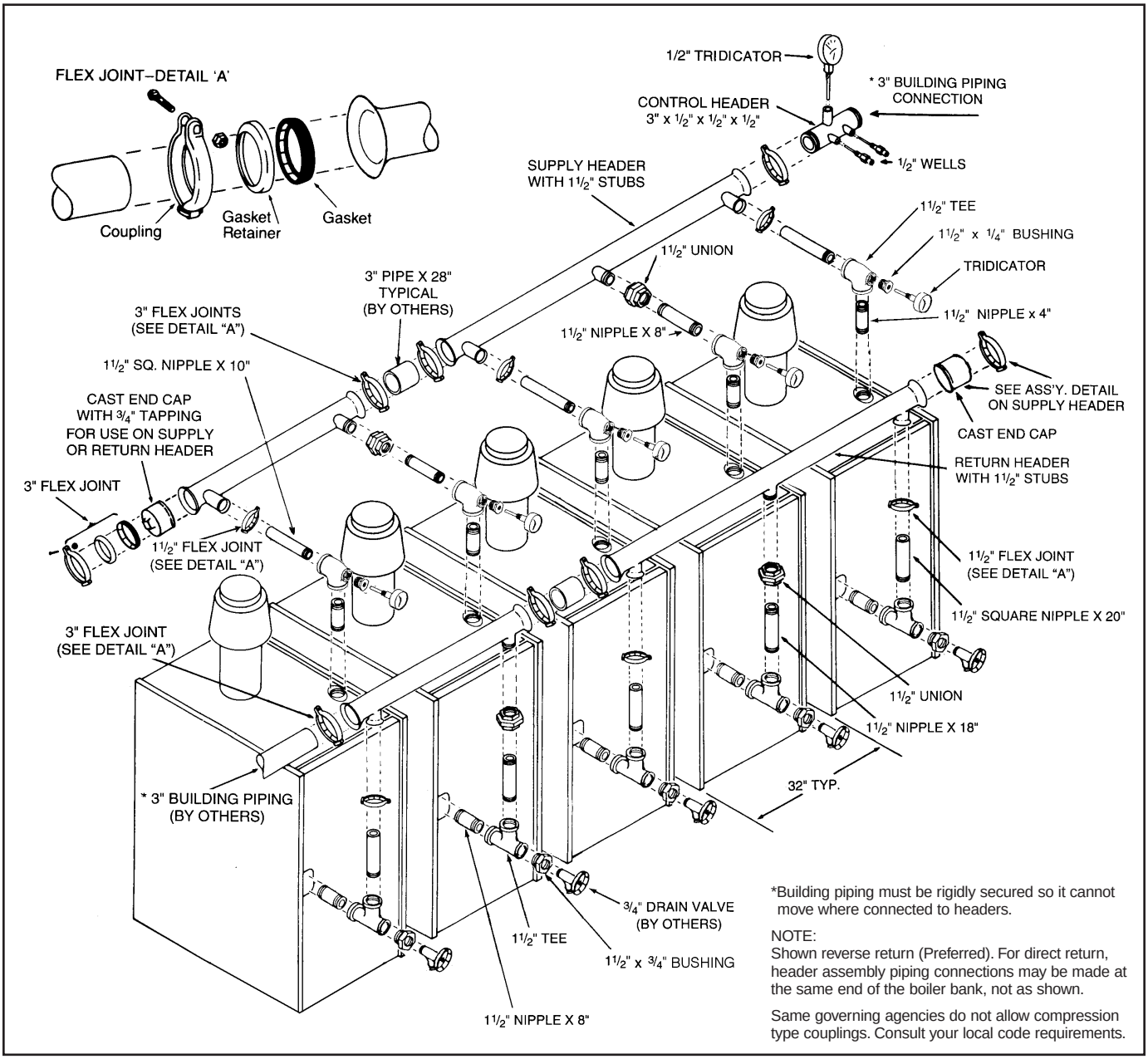



***Figure 6. Gas Caravan—optional header assembly for all models GGT hot water Caravan systems***

## BOILER ROOM DESIGN

Caravan modular boiler systems allow better utilization of floor space and permit future expansion with minimum cost. Caravan modules are hand truckable, fit through doorways and often may be installed around an existing inoperative boiler. They can be grouped in heating module batteries of single, multiple or angular rows. Gas-fired boiler systems consisting of 11 or more modules should be piped in parallel in two or more batteries. Illustrated on the following page are typical boiler room layouts and dimensional data on the size requirements of gas-fired hot water boilers.

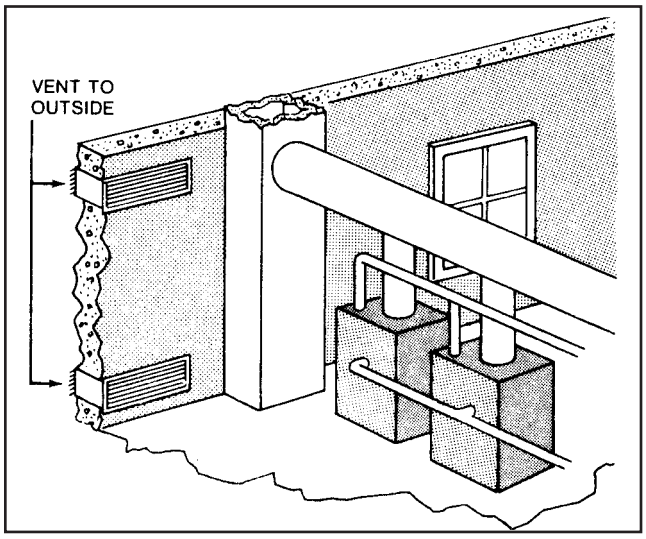



***Figure 7: Correct location of combustion-air supply ducts***

## BOILER ROOM AIR SUPPLY

To ensure safe, efficient operation, the modular boiler system must be supplied with sufficient air to support complete combustion, replacing air entering draft dampers or draft hoods and ventilating the boiler room or areas.
For additional information, not listed below, see ANSI, Z223.1, section 5.3.3.

INSTALLATION IN ENCLOSED BOILER ROOM REQUIRES TWO UNOBSTRUCTED OPENINGS FOR PASSAGE OF AIR INTO THE BOILER ROOM:

1. **Air drawn horizontally from outdoors DIRECTLY through an outside wall;** one louvered opening near the floor (below burner air inlet) and one louvered open ing near the ceiling (above the highest draft regulator), each opening with a minimum FREE air passage area of **1 square inch per 4000 BTUH** of total system input.

2. **Air drawn horizontally through HORIZONTAL DUCTS;** one opening near the floor (below burner inlet) and one opening near the ceiling (above the highest draft regulator), each opening with a minimum FREE air passage area of **1 square inch per 2000 BTUH** of total system input.

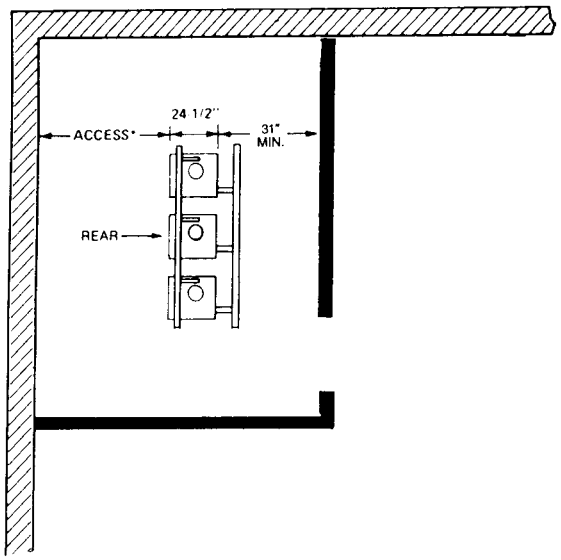
3. **Air drawn VERTICALLY from outdoors**; one opening at the floor and one opening at the ceiling, each opening with a minimum FREE air passage area of **1 square inch per 4000 BTUH** of total system input.

4. **Air drawn from inside the building;** one opening near the floor (below burner inlet) and one opening near the ceiling (above the highest draft regulator), each opening with a minimum FREE air passage area of **1 square inch per 1000 BTUH** of total system input.

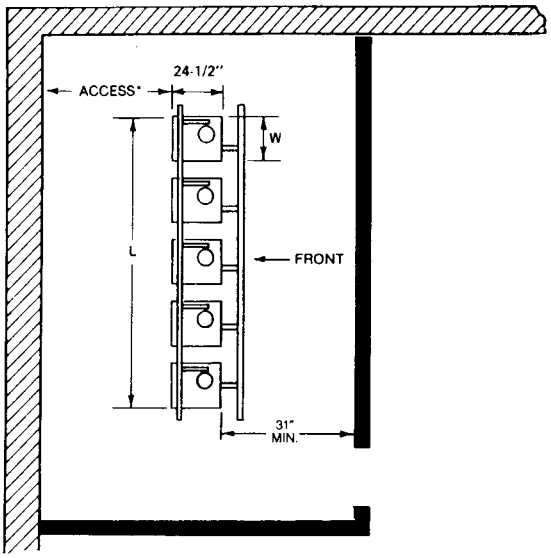
IF BOILERS ARE INSTALLED ADJACENT TO OTHER FUEL BURNING EQUIPMENT, THE AREA OF FREE OPENINGS MUST BE APPROPRIATELY INCREASED TO ACCOMMODATE THE ADDITIONAL LOAD.

UNLESS PROPERLY CONTROLLED, AVOID THE USE OF FORCED VENTILATION, SINCE IT CAN CREATE AN UNDESIRABLE PRESSURE DIFFERENTIAL BETWEEN BOILER ROOM AND AIR SOURCE.

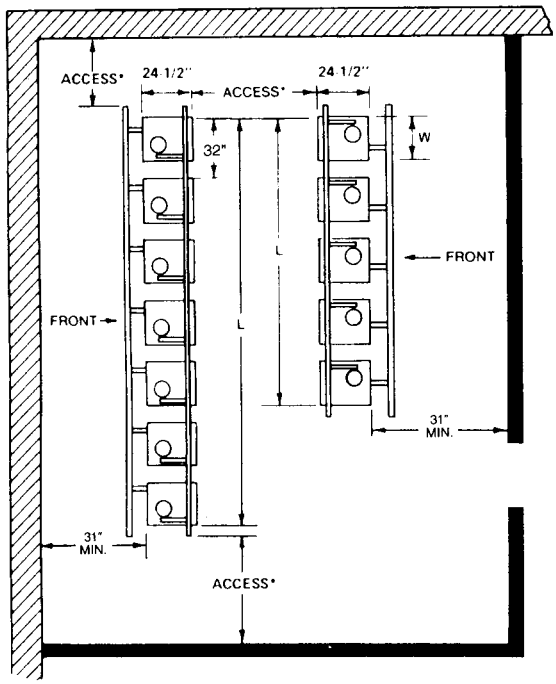
See Table 1 and Figure 1 for "L" and "D" dimensions and for the distance that the OPTIONAL factory header piping extends over the left and right ends of the boiler bank.



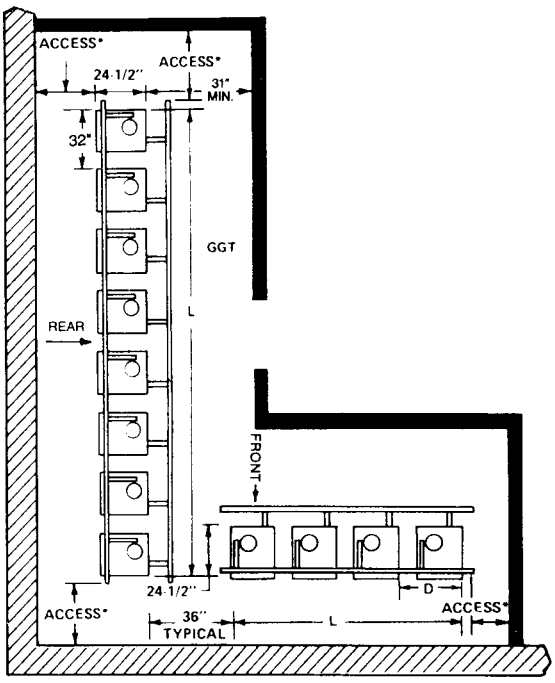

*One Battery of Model GGT-1125 hot water boilers with 375 MBh input per module.*




*One battery of Model GGT-1875 hot water boilers with 375 MBh input per module.*




*One battery of Model GGT-2625 and one battery of Model GGT-1875 hot water boilers total input 4500 MBh, with 375 MBh input per module.*




*One battery of Model GGT-3000 hot water boiler with 375 MBh input per module and one battery of GGT-1200 hot water boilers with 300 MBh input per module.*

**Caravan can be installed with minimum clearances to the walls as per local codes. However 24" is ideally recommended for service inspection access.*

***Figure 8. Typical layouts for gas-fired systems***

## VENTING A GAS-FIRED SYSTEM

A boiler venting system provides an escape path for the products of combustion. There are three major components for venting a gas-fired Caravan: a draft hood for each module, a breeching manifold and a chimney.

### Draft Hood

The draft hood is part of each boiler module, although shipped in a separate carton. It compensates for excessive draft that can be caused by the venturi effect of winds passing over the top of the chimney. The dimensional relationships between the draft hood, the boiler and surface on which the boiler is mounted, are critical. These factors are all interdependent in allowing the draft hood to function without moving parts. Attempts to alter these dimensions can result in unsafe operating conditions.

Note: When mounting the modules on a raised platform, be certain the platform extends past the edge of the modules at least 3 inches on all sides.

### Breeching

Breeching is a term used to describe a manifold(s) that connects individual boiler modules to a chimney. Breeching is usually constructed of sheet metal having a smooth interior surface with all joints made tight against leakage. Pitch breeching up toward chimney. Horizontal breeching size should be maintained for the total length. Any transitions should be made after 4 modules. Connection should be made at a 45° angle in the direction of the chimney. See figure 10.

***Table 2.*** **Breeching dimensions for gas-fired systems GGT and GGHT series: hot water boilers.**

| Model No. | Consists of | | Chimney Height* | | | |
|---|---|---|---|---|---|---|
| | No. of Modules | Module No. | 20 Feet | 25 Feet | 30 Feet | 50 Feet |
| GGT-400E | 2 | GG-200EC | 9" | 9" | 8" | 8" |
| GGT-500E | 2 | GG-250EC | 10" | 9" | 9" | 8" |
| GGT-600E | 2 | GG-300EC | 12" | 10" | 10" | 9" |
| GGHT-700E | 2 | GG-350HEC | 12" | 12" | 10" | 10" |
| GGHT-750E | 2 | GG-375HEC | 12" | 12" | 12" | 10" |
| GGHT-800E | 2 | GG-399HEC | 12" | 12" | 12" | 10" |
| GGT-900E | 3 | GG-300EC | 14" | 12" | 12" | 12" |
| GGHT-1050E | 3 | GG-350HEC | 14" | 14" | 14" | 12" |
| GGHT-1125E | 3 | GG-375HEC | 14" | 14" | 14" | 12" |
| GGHT-1200E | 3 | GG-399HEC | 16" | 14" | 14" | 12" |
| GGT-1200E | 4 | GG-300EC | 16" | 14" | 14" | 12" |
| GGHT-1400E | 4 | GG-350HEC | 16" | 16" | 16" | 14" |
| GGHT-1500E | 4 | GG-375HEC | 16" | 16" | 16" | 14" |
| GGT-1500E | 5 | GG-300EC | 16" | 16" | 16" | 14" |
| GGHT-1600E | 4 | GG-399HEC | 18" | 16" | 16" | 14" |
| GGHT-1750E | 5 | GG-350HEC | 18" | 18" | 16" | 14" |
| GGHT-1875E | 5 | GG-375HEC | 18" | 18" | 18" | 16" |
| GGHT-2000E | 5 | GG-399HEC | 20" | 18" | 18" | 16" |
| GGHT-2100E | 6 | GG-350HEC | 20" | 18" | 18" | 16" |
| GGHT-2250E | 6 | GG-375HEC | 20" | 20" | 18" | 16" |
| GGHT-2400E | 6 | GG-399HEC | 20" | 20" | 20" | 18" |
| GGHT-2450E | 7 | GG-350HEC | 20" | 20" | 20" | 18" |
| GGHT-2625E | 7 | GG-375HEC | 22" | 20" | 20" | 18" |
| GGHT-2800E | 7 | GG-399HEC | 22" | 22" | 20" | 18" |
| GGHT-2800E | 8 | GG-350HEC | 22" | 22" | 20" | 18" |
| GGHT-3000E | 8 | GG-375HEC | 24" | 22" | 22" | 20" |
| GGHT-3150E | 9 | GG-350HEC | 24" | 22" | 22" | 20" |
| GGHT-3200E | 8 | GG-399HEC | 24" | 22" | 22" | 20" |
| GGHT-3375E | 9 | GG-375HEC | 24" | 24" | 22" | 20" |
| GGHT-3500E | 10 | GG-350HEC | 24" | 24" | 22" | 20" |
| GGHT-3600E | 9 | GG-399HEC | 26" | 24" | 24" | 20" |
| GGHT-3750E | 10 | GG-375HEC | 26" | 24" | 24" | 22" |
| GGHT-4000E | 10 | GG-399HEC | 26" | 26" | 24" | 22" |

Based on single row of modules with no elbows.
* Height measured from top of draft hood to top of chimney.
NOTE: For conditions other than those shown, consult factory, or National Fuel Gas Code NFPA 54

Run breeching as high as clearance permits to obtain maximum vertical rise of individual boiler vents. Note that this does not alter chimney height (the height from hood skirt to chimney top). The portion of chimney height rising directly above each hood is most effective in preventing spillage. When the boiler room is in unheated space, insulate vent pipe and breeching to maintain flue gas temperature and good chimney operation. **It is not permitted to lower draft hood skirt height to achieve pitch, or to compensate for low ceilings**. For some combinations of low chimneys, ceilings and long breeching, a draft inducer may be needed. Inducers when required are locally specified and warrantied. The breeching should extend into, but not beyond, the chimney liner.

### Chimney

Caravan gas-fired modular boilers operate efficiently with masonry or prefabricated chimneys as well as with “Type B” or double-walled metal vent pipe. This latter type of chimney construction is generally the least expensive. Chimney height is usually governed by the building height and the size of the boilers (see Table 1). However, the chimney should be high enough to minimize the effects of turbulent winds and pressure common near roof-top obstruction. A vent cap should be used where permitted for additional protection against adverse wind conditions and precipitation. The National Board of Fire Underwriters recommend that the chimney should extend at least 3 feet above the roof and be 2 feet higher than any obstruction within 10 feet.

### Sizing Horizontal Breeching Connectors and Chimneys for Gas-Fired Systems

Horizontal breeching connectors shall be constant sized. The chimney and the horizontal breeching connector are sized using Table 2.

When there are multiple banks of boilers, the horizontal breeching connector for each bank is sized using Table 2. To size the common horizontal breeching connector, add up the total input and refer to Table 2 to size.

The minimum chimney opening will be equal to the size of the largest horizontal breeching section connected to it.

### Horizontal Breeching Connector Length

The **MAXIMUM** length of the horizontal breeching connector length between the chimney and the closest boiler shall *NOT* be longer than 12 inches per inch of horizontal breeching connector diameter, i.e. if the horizontal breeching connector is 16" D., the **MAXIMUM** length from the chimney to the first boiler would be 16" x 12" or 192 inches. The **MINIMUM** length shall be 12 inches regardless of the horizontal breeching connector diameter. See figure 9.

**Vent Connector Diameters (20' chimney*)**

| Model | Flue Outlet Size | Connector | | |
|---|---|---|---|---|
| | | 3' High | 2' High | 1' High |
| GG-200C | 7" | 7" | 7" | 8" |
| GG-250C | 8" | 8" | 8" | 10" |
| GG-300C | 8" | 8" | 10" | 10" |
| GG-350H | 9" | 9" | 10" | 12" |
| GG-375-HC | 10" | 10" | 10" | 12" |
| GG-399HC | 10" | 10" | 12" | 12" |

Based on single row of modules with no elbows.
NOTE: For conditions other than those shown, consult factory, or National Fuel Gas Code NFPA 54

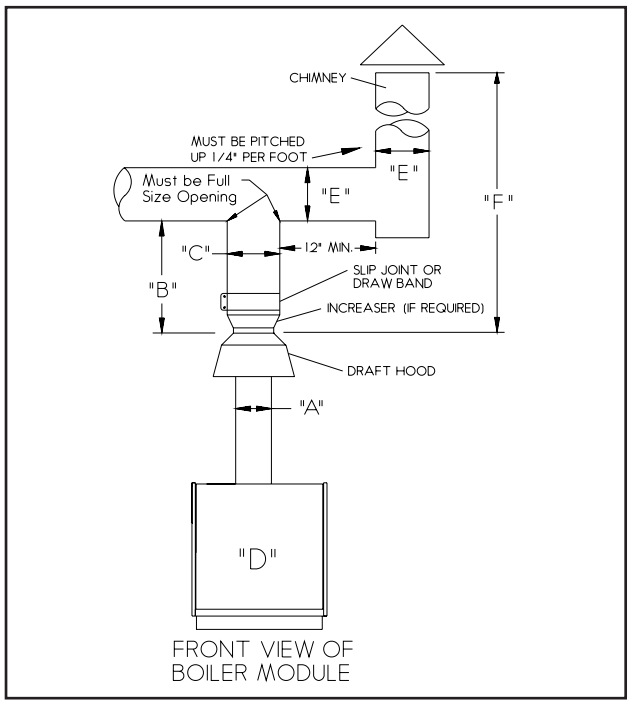



***Figure 9. Connector Rise***

## GAS PIPING

This section contains sizing and construction recommendations for fuel supply piping to Caravan gas-fired modular boiler systems. Gas-fired equipment must conform not only to codes of local regulatory agencies, but also to additional specifications that may be imposed by the utility or gas supplier. Therefore, the following information should be considered only as a guideline.

Figure 11 illustrates a typical gas supply line installation. It consists of a main between the utility's meter box and the boiler system, a main shut-off valve sediment trap, gas header pipe and drip legs on individual boilers.

Individual gas lines to individual boiler modules should be ¾" diameter. Size of gas main and header pipes depends on volume of gas required and acceptable pressure drop between meter and modules' gas regulator valves. Minimum pressure required at each valve is 5 inches of water column for natural gas and 11 inches for propane gas, measured while all boilers and other gas-fired equipment on the same meter are firing. Small variations in gas flow can be compensated for by adjusting gas regulator valves. However, final pressure of gas header must vary no more than+ 0.3 in. of water column.

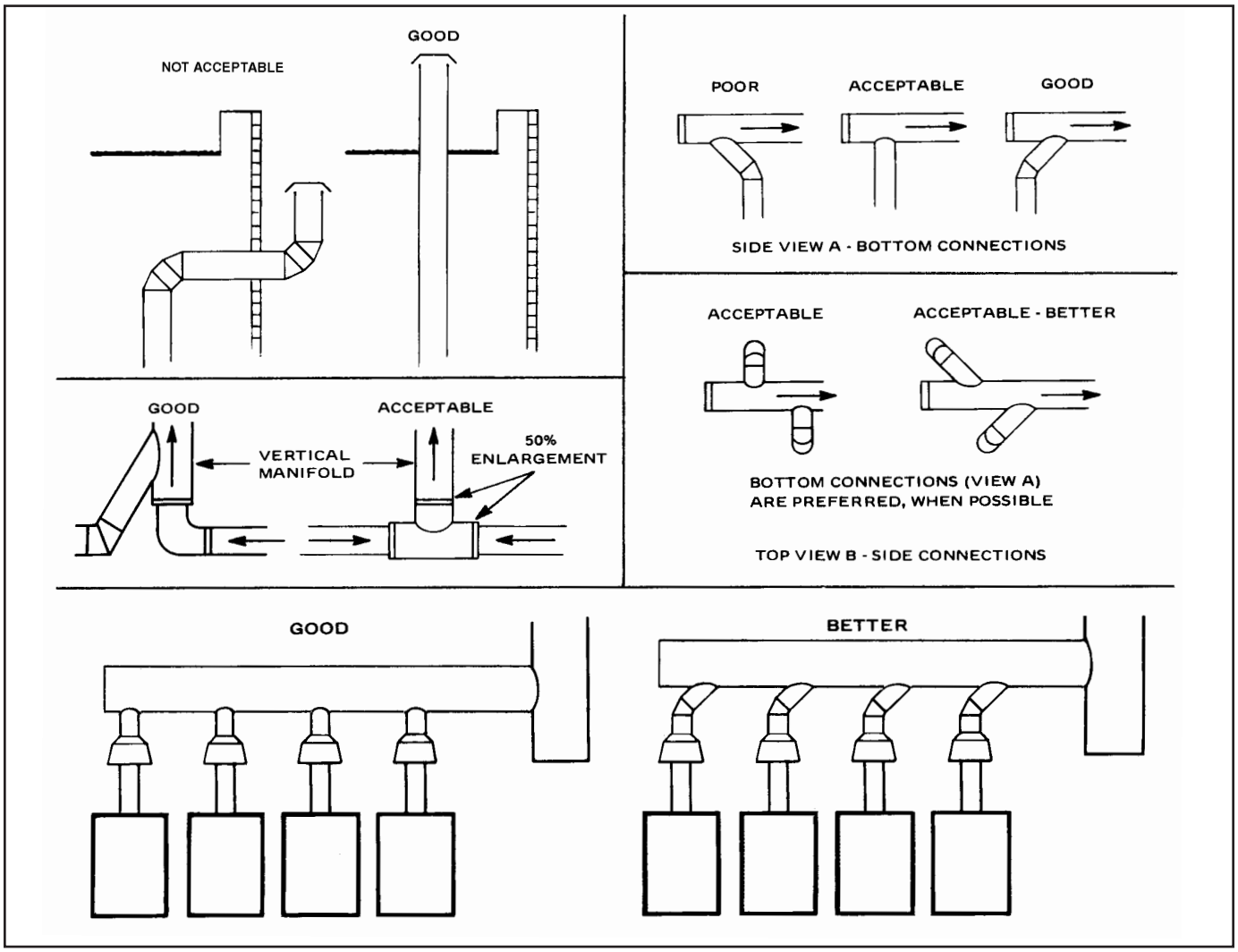



***Figure 10. Suggested venting system constructions***

Table 3: Gas consumption rate hot water boilers only

| Model No. | Gas Consumption In CFH |
|---|---|
| GGT-400E | 400 |
| GGT-500E | 500 |
| GGT-600E | 600 |
| GGHT-700E | 700 |
| GGHT-750E | 750 |
| GGHT-800E | 798 |
| GGT-900E | 900 |
| GGHT-1050E | 1050 |
| GGHT-1125E | 1125 |
| GGHT-1200E | 1197 |
| GGT-1200E | 1200 |
| GGHT-1400E | 1400 |
| GGHT-1500E | 1500 |
| GGT-1500E | 1500 |
| GGHT-1600E | 1596 |
| GGHT-1750E | 1750 |
| GGHT-1875E | 1875 |
| GGHT-2000E | 1995 |
| GGHT-2100E | 2100 |
| GGHT-2250E | 2250 |
| GGHT-2400E | 2394 |
| GGHT-2450E | 2450 |
| GGHT-2625E | 2625 |
| GGHT-2800E | 2793 |
| GGHT-2800E | 2800 |
| GGHT-3000E | 3000 |
| GGHT-3150E | 3150 |
| GGHT-3200E | 3192 |
| GGHT-3375E | 3375 |
| GGHT-3500E | 3500 |
| GGHT-3600E | 3591 |
| GGHT-3750E | 3750 |
| GGHT-4000E | 3990 |

**Gas Main Sizing**

To determine the correct pipe diameter for the gas main serving a specific Caravan system, proceed as follows:

a. Follow the building plans, find total length of straight pipe between supply from gas meter and boiler gas header.
b. Using data in Table 4, calculate equivalent linear length of screw pipe fittings used in fabrications of main. Add this to figure from step (a) to obtain equivalent total length.
c. Find Caravan gas consumption in cubic feet per hour from Table 3 in hot water systems.
d. Multiply the system total hourly gas consumption by flow correction value from Table 5.
e. Locate system's total equivalent pipe length in right column of Table 6.
f. Move vertically to the system's corrected flow rate calculated in step (c). If this value falls between two of those listed, select larger value.
g. From this point move horizontally to the left column and read suggested pipe diameter for gas main.

***Table 4: Equivalent linear length in feet of standard iron pipe fittings for natural gas***

| Pipe Size Inches | Elbow | | | Valve | | | Return Bend | Side Outlet Tee |
|---|---|---|---|---|---|---|---|---|
| | Standard | Medium Sweep | Long Sweep | Gate | Globe | Angle | | |
| 1/2 | 0.84 | 0.52 | 0.41 | 0.031 | 2.50 | 1.12 | 1.25 | 1.66 |
| 3/4 | 1.17 | 0.73 | 0.57 | 0.044 | 3.50 | 1.84 | 1.75 | 2.33 |
| 1 | 1.57 | 0.98 | 0.77 | 0.057 | 4.68 | 2.11 | 2.34 | 3.11 |
| 1-1/4 | 2.19 | 1.37 | 1.07 | 0.082 | 6.54 | 2.94 | 3.27 | 4.35 |
| 1-1/2 | 2.63 | 1.64 | 1.29 | 0.098 | 7.84 | 3.52 | 3.92 | 5.21 |
| 2 | 3.55 | 2.23 | 1.74 | 1.320 | 10.60 | 4.77 | 5.30 | 7.05 |
| 3 | 5.72 | 3.59 | 2.81 | 2.130 | 17.08 | 7.69 | 8.84 | 11.40 |

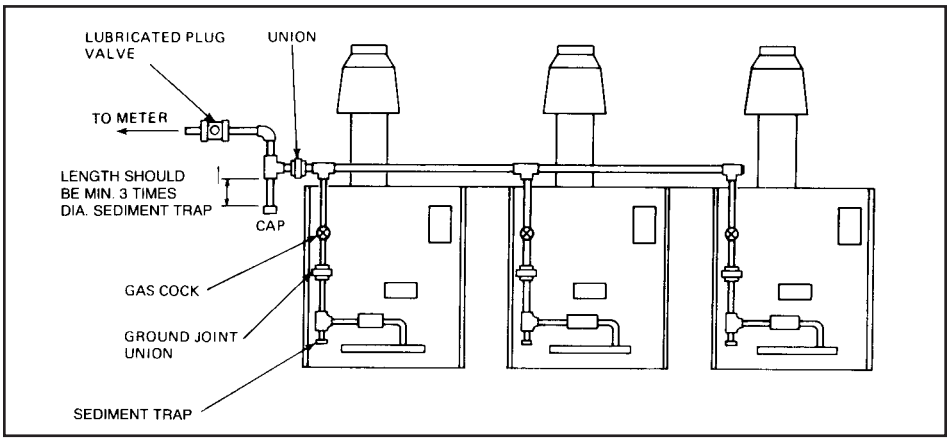



***Figure 11. Typical gas supply line installation***

***Table 5. Characteristics of various fuel gases***

| Type of Gas | Heating Valve*† | Flow Correction Factor |
|---|---|---|
| Natural | 1000 Btu | 1.00 |
| Propane | 2500 Btu | 1.10 |

* per cubic foot
† Consult fuel supplier for actual BTU value.

***Table 6. Gas main sizing guide***

| Nominal Iron Pipe Size Inches | Internal Diameter Inches | Equivalent Length of Pipe, Feet | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | **10** | **20** | **30** | **40** | **50** | **60** | **70** |
| 1/4 | .364 | 32 | 22 | 18 | 15 | 14 | 12 | 11 |
| 3/8 | .493 | 72 | 49 | 40 | 34 | 30 | 27 | 25 |
| 1/2 | .622 | 132 | 92 | 73 | 63 | 56 | 50 | 46 |
| 3/4 | .824 | 278 | 190 | 152 | 130 | 115 | 105 | 96 |
| 1 | 1.049 | 520 | 350 | 285 | 245 | 215 | 195 | 180 |
| 1 1/4 | 1.380 | 1,050 | 730 | 590 | 500 | 440 | 400 | 370 |
| 1 1/2 | 1.610 | 1,600 | 1,100 | 890 | 760 | 670 | 610 | 560 |
| 2 | 2.067 | 3,050 | 2,100 | 1,650 | 1,450 | 1,270 | 1,150 | 1,050 |
| 2 1/2 | 2.469 | 4,800 | 3,300 | 2,700 | 2,300 | 2,000 | 1,850 | 1,700 |
| 3 | 3.068 | 8,500 | 5,900 | 4,700 | 4,100 | 3,600 | 3,250 | 3,000 |
| 4 | 4.026 | 17,500 | 12,000 | 9,700 | 8,300 | 7,400 | 6,800 | 6,200 |
| | | **80** | **90** | **100** | **125** | **150** | **175** | **200** |
| 1/4 | .364 | 11 | 10 | 9 | 8 | 8 | 7 | 6 |
| 3/8 | .493 | 23 | 22 | 21 | 18 | 17 | 15 | 14 |
| 1/2 | .622 | 43 | 40 | 38 | 34 | 31 | 28 | 26 |
| 3/4 | .824 | 90 | 84 | 79 | 72 | 64 | 59 | 55 |
| 1 | 1.049 | 170 | 160 | 150 | 130 | 120 | 110 | 100 |
| 1 1/4 | 1.380 | 350 | 320 | 305 | 275 | 250 | 225 | 210 |
| 1 1/2 | 1.610 | 530 | 490 | 460 | 410 | 380 | 350 | 320 |
| 2 | 2.067 | 990 | 930 | 870 | 780 | 710 | 650 | 610 |
| 2 1/2 | 2.469 | 1,600 | 1,500 | 1,400 | 1,250 | 1,130 | 1,050 | 980 |
| 3 | 3.068 | 2,800 | 2,600 | 2,500 | 2,200 | 2,000 | 1,850 | 1,700 |
| 4 | 4.026 | 5,800 | 5,400 | 5,100 | 4,500 | 4,100 | 3,800 | 3,500 |

*Maximum capacity of pipe in cubic feet of gas per hour for gas pressures of 0.5 Psig or less and a pressure drop of 0.3 inch water column (based on a 0.60 specific gravity gas).*

# CONTROLS

## THE BOILER STAGING CONCEPT

The heart of the Caravan boiler plant is a temperature-actuated control system that automatically stages only those boiler modules needed to meet the heating demand in a given period, thereby conserving fuel.

In a staging control system, each stage ordinarily activates one boiler module. With appropriate wiring, multiple modules can be grouped within a stage.

During a fluctuation in heating requirements, a large central boiler cycles on and off to match heat output to building demand. A staged modular boiler system, on the other hand, will energize only as many modules as the system load requires. Only one stage cycles at a time. The other stages remain off or operate continuously, thereby performing at peak efficiency. For example, in a 10 module boiler system, with the heating load at 61% of capacity, six of the modules operate continuously at peak efficiency. Fractional heating requirements are supplied by the seventh "cycling" module, while the remaining three modules are "off." This is in contrast to a single large central boiler that simply cycles on and off, resulting in lower efficiency.

Over-sizing is a major factor in poor system efficiency. Most of the time a single central boiler is oversized. Historical data shows that many single central boilers are considerably oversized even at the outdoor temperature for which they were designed. Modular boiler systems are not oversized by more than a portion of one module, regardless of the load.

The Caravan control system automatically compensates for seasonal temperature changes. It energizes more or fewer boilers, depending on changes of outside temperature, system water temperature, or both. Modules save energy by operating in long cycles at full-rated output and maximum efficiency.

## CONTROL SYSTEM SELECTION

There are three levels of Caravan System Controls (SC). The choice of one system over another depends on several factors: The type of boilers (hot water or steam, gas or oil), the number of stages and modules involved, and the relative importance of installation costs, fuel economy and occupant comfort as design objectives. Caravan modular boiler control systems are not intended to be the sole building temperature control. Zone controls are required.

### 400 SERIES CONTROL SYSTEM

The 400 series control system provides staging operation to regulate system water temperature with a fixed-ratio, single stage outdoor reset control. The 400 series control is primarily for small to medium sized (2, 3 or 4 boilers) gas-fired Caravan systems, where lead/lag is not critical. The supply water temperature is automatically adjusted up or down based on outdoor temperature. Multiple outdoor temperature controls actuate the number of heating modules needed, depending on outdoor temperature. These modules are then cycled as a group by the outdoor reset control.

The outdoor reset control has two sensors; one 30 foot long sensor monitoring the outdoor temperature, and one 10 foot long sensor monitoring the system water temperature. The reset ratio is nonadjustable and generally sufficient to provide adequate space heating in most climates.

The SCG400 system control group includes the specified 400 series control panel(s) plus all operating and safety controls listed in the bill of materials.

**BILL OF MATERIALS - SCG400**

**Space heating only**

1 — Temperature reset control, T475A, for north wall (with sunshield).
* — Outdoor temperature control, T675A, for north wall (with sunshields). * One for each space heating module, in excess of one.
1 — System enable temperature control, T675A, for north wall (with sunshield).
1 — Low water cutoff, PS-851M-120.
1 — Manual reset hi-limit, L4006E.

**Space and domestic hot water heating**

1 — Temperature reset control, T475A, for north wall (with sunshield).
* — Outdoor temperature control, T675A, for north wall (with sunshields). * One for each space heating module, in excess of one.
1 — System enable temperature control, T675A, for north wall (with sunshield).
1 — Low water cutoff,PS-851M-120.
1 — Manual reset hi-limit, L4006E.
1 — Domestic hot water, temperature control, L6006A.
1 — Domestic hot water motorized valve, EMV II.

Relays required are to be field furnished. See wiring diagram.

### 1200 SERIES CONTROL SYSTEM

The 1200 series control system is an extremely accurate and flexible multi-stage microprocessor based control system with automatic lead/lag, designed to sequence heating modules based on outdoor air temperature and supply water temperature. This control is generally applied on systems with up to 10 modules. The SC1200 panel consists of a microprocessor mounted in a sheet metal box with adequate wiring knockouts. The panel is furnished with outdoor sensor and water temperature sensor. In the event of a power failure, the control turns all stages off with a time delay between stages for starting when power is restored. The SC1200 panel has an adjustable reset ratio, control band and set point and controls 2 through 6 stages. When used with the EC1200 4-stage expansion panel, up to 10 stages of operation are provided. Individual stage indicating lights are visible with panel cover removed. Desired number of stages can be set in the field. On systems requiring automatic lead/lag and domestic hot water or for systems with more than 10 modules, the 2000 series control system is recommended. If Domestic Hot Water is used with the 1200 series control system, lead/lag must be disabled.

The SCG1200 system control group includes the specified 1200 series control panel(s) plus all operating and safety controls listed in the bill of materials.

**BILL OF MATERIALS - SCG1200**

**Space heating only — 2-6 modules**

1 — Microprocessor, 2-6 stage standard system control panel SC1200.
1 — Outdoor temperature sensor, C7031G.
1 — Supply water temperature sensor, C7170A.
1 — Supply water temperature sensor well and housing, C7031D.
1 — System enable temperature control, T675A, for north wall (with sunshield).

1 — Low water cutoff, PS-851M-120.
1 — Manual reset hi-limit, L4006E.

In addition to the above, the following additional components are provided for systems with 7 to 10 modules.
1 — Microprocessor, 7-10 stage standard expansion control panel, EC1200.

OPTIONAL ACCESSORIES
Pump Control (SC1200 series only)
- automatic pump failure change-over
- manual pump selector switch
- alarm circuit and light

Test plug kit
- speed up testing and troubleshooting.

Consult factory for other desired options.

**2000 SERIES CONTROL SYSTEM**
The 2000 series control system is a factory-wired multi-stage microprocessor controlled system which incorporates all the components and features of the 1200 series control system, plus visual display readout and provisions for domestic hot water with automatic lead/lag and night set-back features. The system control panel (SC2000) is a NEMA-1 enclosure with a hinged door and keyed lock. Visible indicator lights identify power, heat and active stages. The components are factory-wired to a terminal strip that is clearly numbered for connection to common system components such as system enable temperature control, manual reset high limit, low water cutoff and accessory panels such as dual pump control. Two types of lead/lag are featured:
• LEAD/LAG (FOFO): When all boilers are off and a call for heat occurs, the stage following the last stage off will be the first stage on; use this selection when it is important to evenly distribute boiler operating time.
• STD (FOFO): When all boilers are off and a call for heat occurs, Stage 1 (closest to the chimney) is always first stage on.

The SCG2000 system control group includes the 2000 series control system panel plus all operating and safety controls listed in the bill of materials.

**BILL OF MATERIALS - SC2000**
All SC2000 System Control Groups have the following standard components:
1 — Microprocessor, 2-4 stage deluxe system control panel
OR
1 — Microprocessor, 2-8 stage deluxe system control panel
PLUS
1 — Outdoor temperature sensor and system enabler
1 — Supply water sensor

The SCG2000 System includes items listed above, plus:
1 — Low water cutoff
1 — Manual reset hi-limit

Other options include:
- Indoor space sensor for non-zoned systems
- Stage relays
- Components for domestic hot water which include:
  EMV II Motorized valve
  DHW thermostat

Circulators, relays, switches and other wiring devices are provided by contractor.

# FIELD WIRING AT MODULES

**Figure C1. Gas standing pilot with field wired vent damper.**

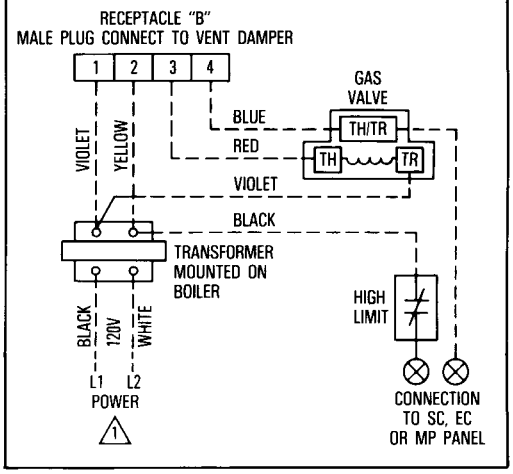



**Figure C2. Gas standing pilot without vent damper.**

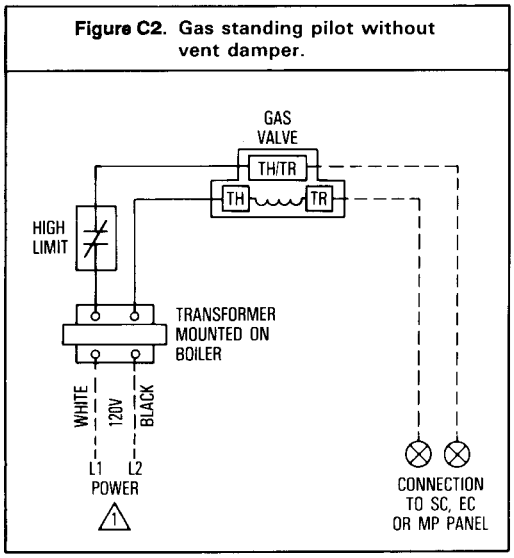



**Figure C3. Gas intermittent ignition with or without vent damper.**

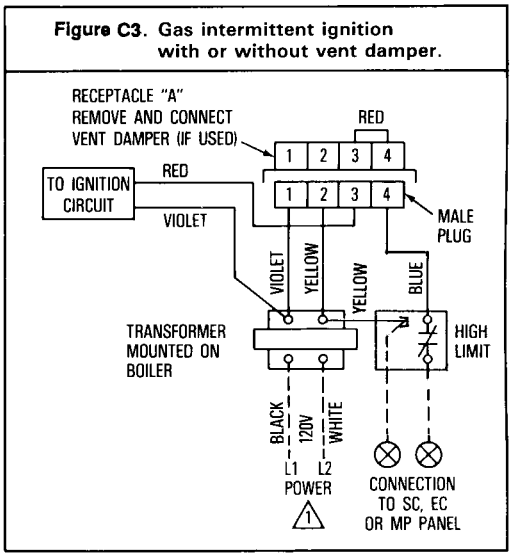



**Figure C4. Multiple manual reset high limit wiring (if used).**

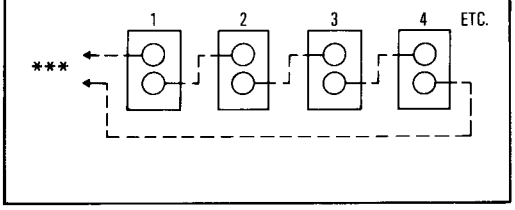
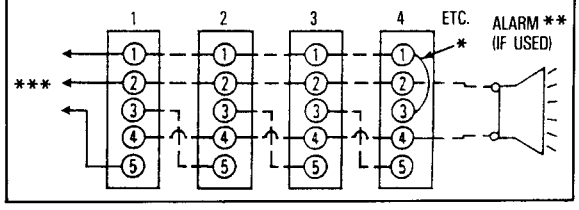



**Figure C5. Multiple low water cutoff wiring (if used).**




1 PROVIDE DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQUIRED

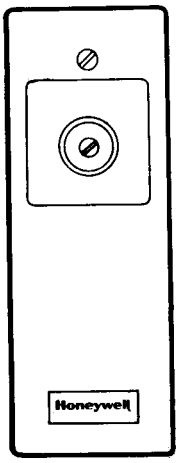
LEGEND:
——— FACTORY WIRING
– – – FIELD WIRING

* Install jumper between Terminals 1 and 3 on last low water cutoff only.
** Optional alarm circuit by contractor.
*** For connection see SC1200 wiring diagrams.

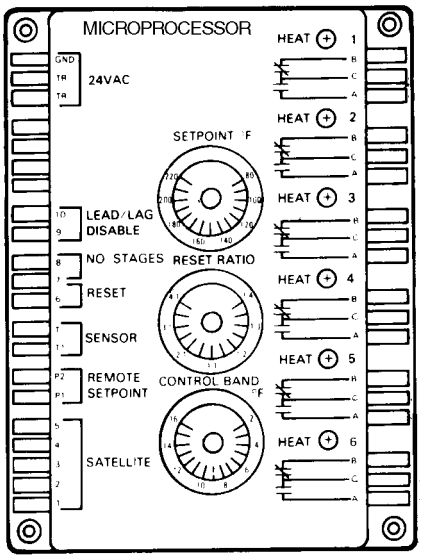
*Table C1. Reset Ratio and Temperature Set Points at Desired Water and Outdoor Design Temperatures*

| Outdoor Design Temperature | Enable T-stat Settings °F | Desired Water Temperature | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 140°F | | 160°F | | 180°F | | 200°F | | 220°F | |
| | | RR | SP | RR | SP | RR | SP | RR | SP | RR | SP |
| +20 | 60 | 2.5:1 | 120 | 1:1 | 110 | 1:1.6 | 100 | 1:2 | 100 | 1:2.4 | 100 |
| +20 | 50 | 1.67:1 | 110 | 1:1.1 | 105 | 1:1.4 | 110 | 1:2.2 | 90 | 1:2.4 | 100 |
| 0 | 60 | 3.5:1 | 120 | 1.4:1 | 110 | 1:1 | 110 | 1:1.28 | 110 | 1:1.56 | 110 |
| 0 | 50 | 3.5:1 | 120 | 1.27:1 | 105 | 1:1.14 | 100 | 1:1.42 | 100 | 1:1.7 | 100 |
| -20 | 60 | 4.5:1 | 120 | 2:1 | 115 | 1.28:1 | 110 | 1:1 | 110 | 1:1.3 | 105 |
| -20 | 50 | 4.5:1 | 120 | 2:1 | 115 | 1.29:1 | 110 | 1:1.11 | 100 | 1:1.32 | 100 |
| -40 | 60 | 4.4:1 | 115 | 2.44:1 | 115 | 1.7:1 | 115 | 1.3:1 | 115 | 1.04:1 | 115 |
| -40 | 50 | 4.4:1 | 115 | 2.2:1 | 110 | 1.57:1 | 110 | 1.2:1 | 110 | 1:1 | 110 |

Note: RR= Reset Ratio
SP= Set Point




**T675A Enable T-stat**




**W7100J Microprocessor**

*Table C2. Recommended Control Band Setting*

| STAGES | CONTROL BAND SETTING |
|---|---|
| 1 | 16 |
| 2 | 16 |
| 3 | 11 |
| 4 | 8 |
| 5 | 6 |
| 6 | 5 |
| 7 | 5 |
| 8 | 4 |
| 9 | 4 |
| 10 | 2 |

*Table C3. W7100J Input Resistance for Number of Controlled Stages*

| STAGES | RESISTORS | |
|---|---|---|
| | COLOR | OHMS |
| 1 | Blue | 100 |
| 2 | Red | 200 |
| 3 | Yellow | 300 |
| 4 | Brown | 400 |
| 5 | Green | 500 |
| 6 | Gray * | 600 |
| 7 | Orange | 700 |
| 8 | White | 800 |
| 9 | Violet | 900 |
| 10 | Black | 1000 |

*6 stage resistor, factory installed.

**NOTES:**

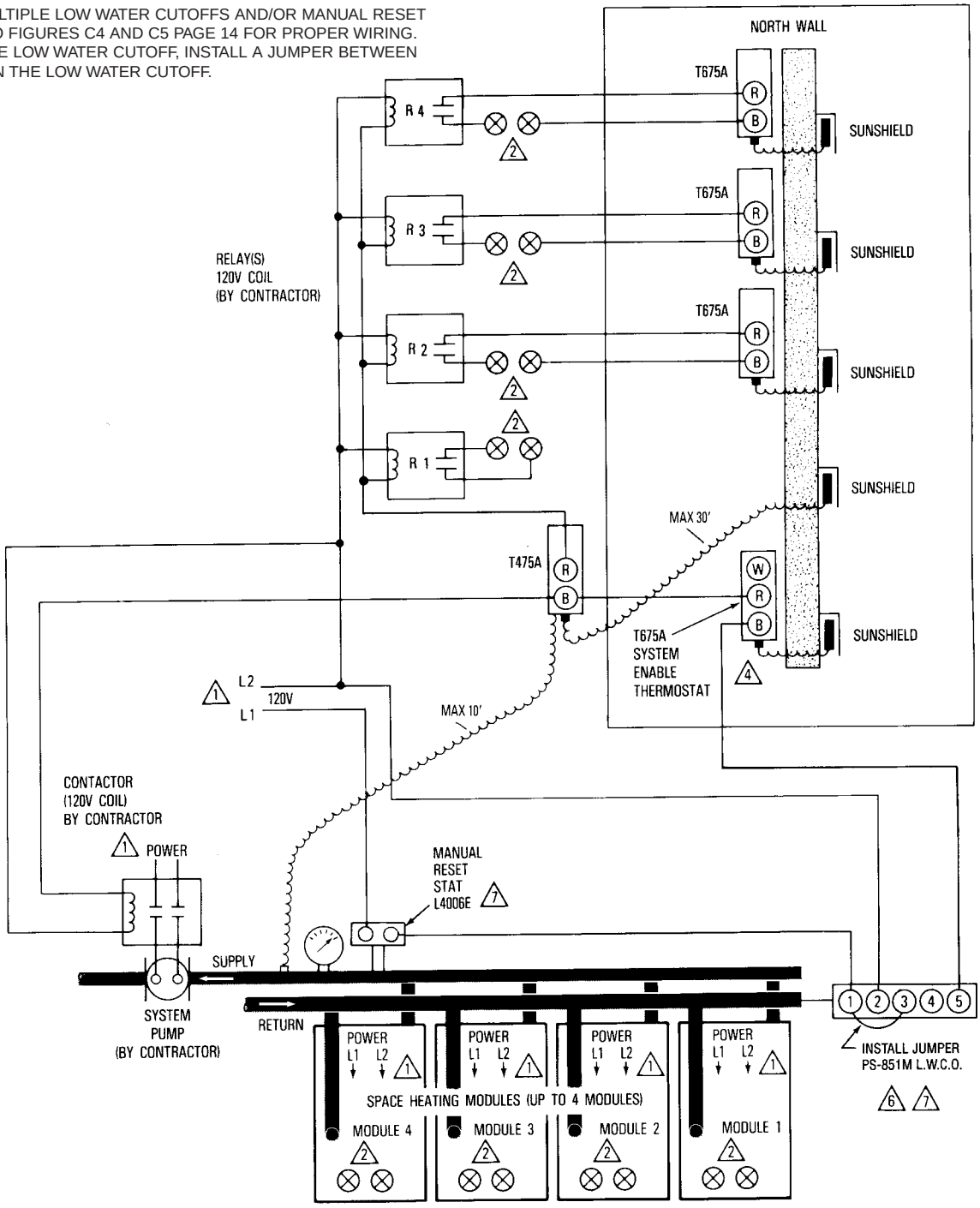
1. **The starting temperature on the microprocessor control is modified from 40°F to 70°F.** When the outdoor temperature is 70°F or above, boiler water will be maintained at the setpoint temperature. Below 70°F outdoor temperature, boiler water temperature will vary according to the reset ratio setting.
2. This control is factory set to operate 6 stages. To change the number of operating stages, the appropriate resistor must be installed **on the microprocessor control,** across spade terminals 7 and 8. Resistors for 1 through 5 stages are shipped with the SC1200 panel. Resistors for 7 through 10 stages are shipped with the EC1200 panel. See Table C3.
3. The Automatic Lead/Lag function can be disabled by installing a jumper **on the microprocessor control**, across spade terminals 9 and 10.
4. On the SC1200 control panel, a jumper must be field installed **on the microprocessor control,** across spade terminals P1 and P2.

## SCG-400-S-4 CARAVAN CONTROL SYSTEM WIRING DIAGRAM

- **Up to 4 space heating modules**

1. POWER SUPPLY, PROVIDE DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQUIRED.
2. SEE FIGURES C1 THROUGH C3 PAGE 14 FOR WIRING TO MODULE ⊗ ⊗ CONNECTIONS.
4. SET SYSTEM ENABLE THERMOSTAT (T675A) AT THE TEMPERATURE THAT THE BUILDING WILL BEGIN TO REQUIRE HEAT (NORMALLY BETWEEN 40°F AND 60°F). MOUNT OUTDOOR SENSING BULB ON NORTH (SHADED) WALL IN SUNSHIELD #34886A.
6. LOW WATER CUTOFFS MUST BE INSTALLED AT A LOCATION HIGHER THAN THE TOP OF THE BOILERS.
7. ON SYSTEMS WITH MULTIPLE LOW WATER CUTOFFS AND/OR MANUAL RESET HIGH LIMITS, REFER TO FIGURES C4 AND C5 PAGE 14 FOR PROPER WIRING. ON SYSTEMS WITH ONE LOW WATER CUTOFF, INSTALL A JUMPER BETWEEN TERMINALS 1 AND 3 ON THE LOW WATER CUTOFF.

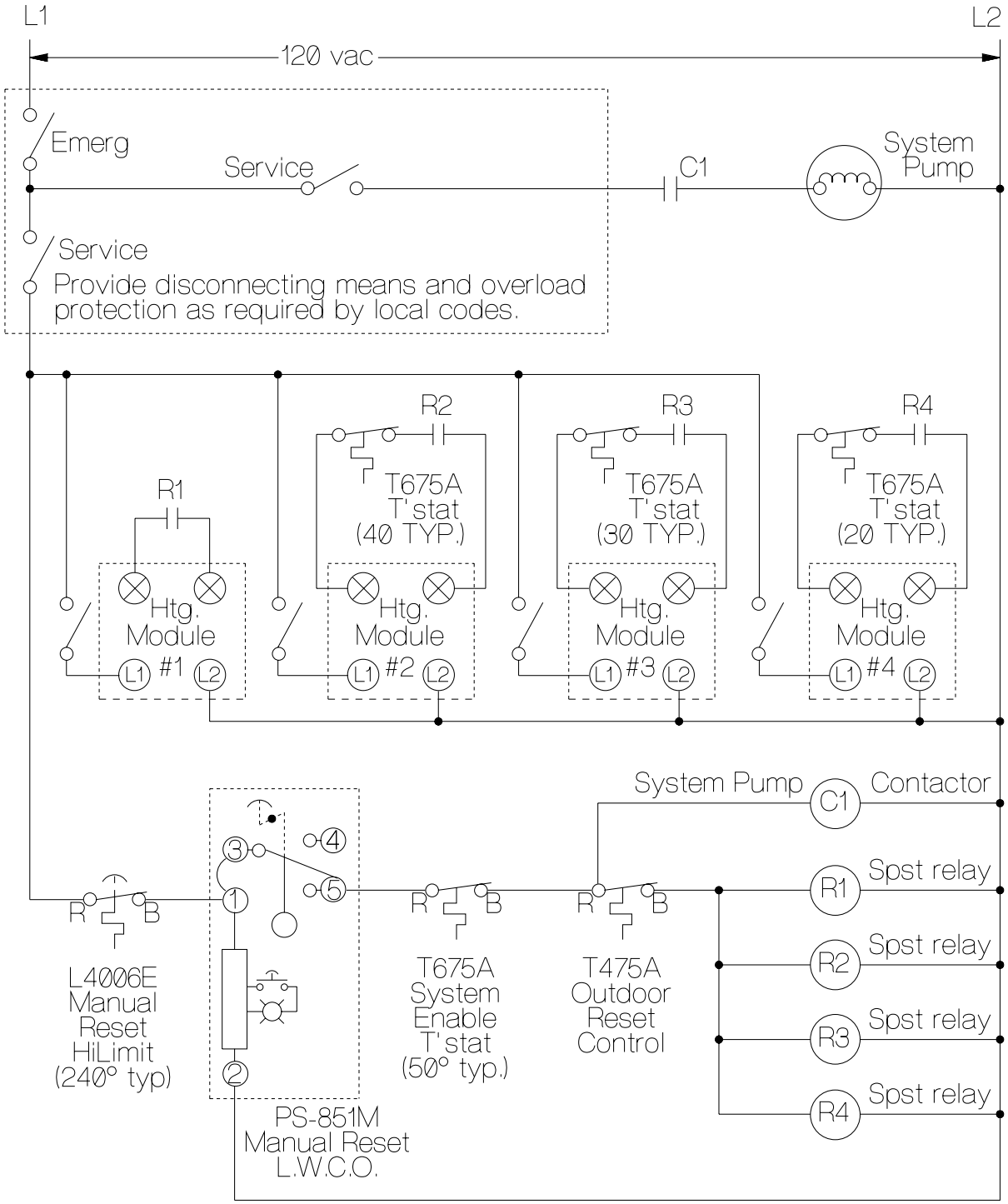
T675A SETTING
Determine the proper setting of each T675A thermostat by calculating the percentage of the total heating load that each T657A will energize and apportion this over the operating temperature range (enable temperature minus design outdoor temperature.




### SEQUENCE OF OPERATIONS - SCG400

**Space heating only**

When outdoor temperature falls below the setting of the system enable temperature control (T675A), the system is activated. The outdoor reset control (T475A) will energize module #1 and regulate the supply water temperature based on outdoor temperature. As the outdoor temperature continues to drop below the settings of the individual module temperature controls (T675A), more stages are energized. The energized modules are cycled as a group by the outdoor reset control (T475A).

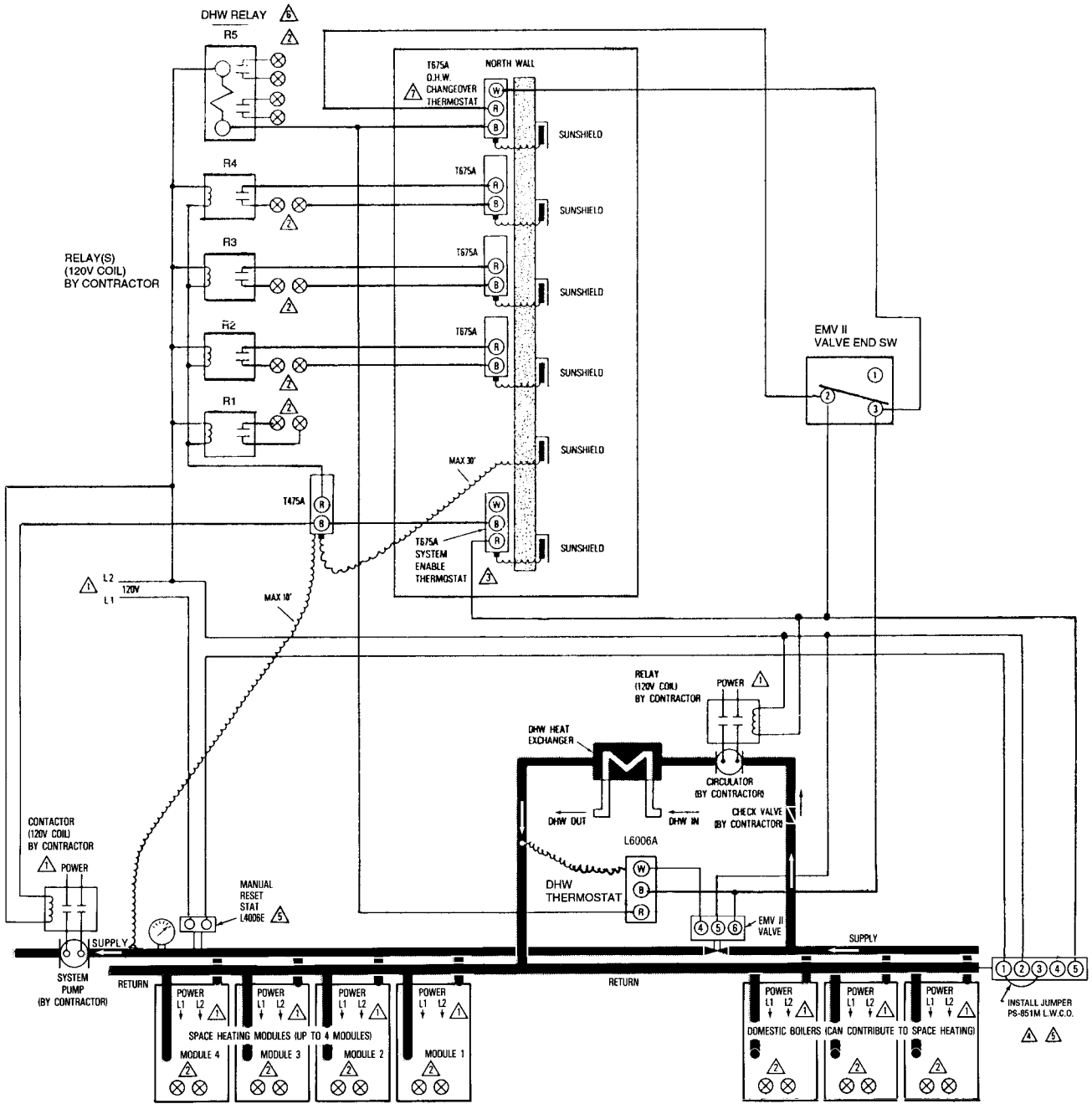



⊗ – SEE FIG. C1 THROUGH C3 FOR CONNECTION AT MODULE.

## SCG-400-D-4 CARAVAN CONTROL SYSTEM WIRING DIAGRAM

- **Domestic hot water and space heating**
- **Up to 4 space heating modules**

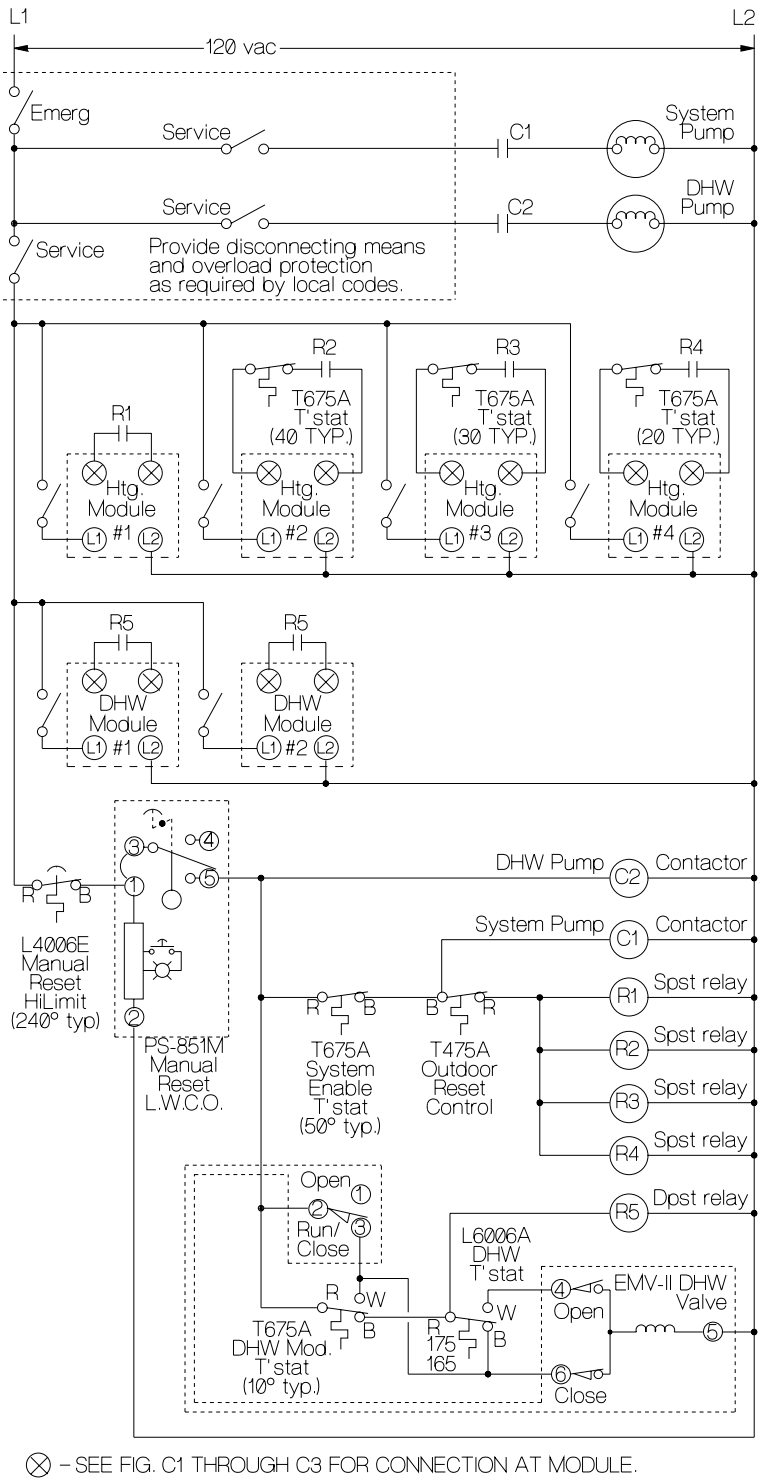
1. POWER SUPPLY, PROVIDE DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQUIRED.
2. SEE FIGURES C1 THROUGH C3 PAGE 14 FOR WIRING TO MODULE ⊗ ⊗ CONNECTIONS.
3. SET SYSTEM ENABLE THERMOSTAT (T675A) AT THE TEMPERATURE THAT THE BUILDING WILL BEGIN TO REQUIRE HEAT (NORMALLY BETWEEN 40°F AND 60°F). MOUNT OUTDOOR SENSING BULB ON NORTH (SHADED) WALL IN SUNSHIELD #34886A.
4. LOW WATER CUTOFFS MUST BE INSTALLED AT A LOCATION HIGHER THAN THE TOP OF THE BOILERS.
5. ON SYSTEMS WITH MULTIPLE LOW WATER CUTOFFS AND/OR MANUAL RESET HIGH LIMITS, REFER TO FIGURES C4 AND C5 PAGE 14 FOR PROPER WIRING.
   ON SYSTEMS WITH ONE LOW WATER CUTOFF, INSTALL A JUMPER BETWEEN TERMINALS 1 AND 3 ON THE LOW WATER CUTOFF.
6. DOMESTIC HOT WATER (DHW) BOILERS CYCLE AS A GROUP THROUGH FIELD SUPPLIED RELAY(S). SEE WIRING DIAGRAMS FOR CONNECTIONS. EACH DHW BOILER REQUIRES A DRY CONTACT CLOSURE. THIS CAN BE DONE WITH INDIVIDUAL RELAY(S) FOR EACH BOILER OR WITH A SINGLE RELAY WITH DRY CONTACTS FOR EACH DHW BOILER(S) AS SHOWN. RELAY(S) ARE FIELD SUPPLIED AND MUST HAVE A 120 VOLT COIL.
7. SET DHW CHANGEOVER THERMOSTAT DESIRED TEMPERATURE FOR DOMESTIC BOILERS TO CONTRIBUTE TO THE SPACE HEATING LOAD.




### SEQUENCE OF OPERATIONS - SCG400

**Space heating and domestic hot water**

Domestic modules maintain hot water year round through a L6006A aquastat, mounted in the boiler return pipe of the DHW heat exchanger. When outdoor air temperature falls below the setting of the system enable temperature control (T675A), the space heating system is activated. The outdoor reset control (T475A) will energize module #1 and modulate the supply water temperature based on outdoor temperature. As the outdoor temperature continues to drop below the settings of the individual module temperature controls (T675A), more modules are energized. The energized modules are cycled as a group by the reset control. When the final outdoor temperature control (T675A) calls, and domestic hot water temperature control (L6006A) is satisfied, the motorized valve opens, allowing the domestic water modules to contribute to space heating.


L1
L2
120 vac
Emerg
Service
C1
System Pump
Service
C2
DHW Pump
Service
Provide disconnecting means and overload protection as required by local codes.
R1
R2
R3
R4
T675A T'stat (40 TYP.)
T675A T'stat (30 TYP.)
T675A T'stat (20 TYP.)
Htg. Module #1
Htg. Module #2
Htg. Module #3
Htg. Module #4
R5
R5
DHW Module #1
DHW Module #2
DHW Pump
C2
Contactor
System Pump
C1
Contactor
R1
Spst relay
R2
Spst relay
R3
Spst relay
R4
Spst relay
R5
Dpst relay
L4006E Manual Reset HiLimit (240° typ)
PS-851M Manual Reset L.W.C.O.
T675A System Enable T'stat (50° typ.)
T475A Outdoor Reset Control
Open
Run/ Close
L6006A DHW T'stat
T675A DHW Mod. T'stat (10° typ.)
175
165
EMV-II DHW Valve
Open
Close
⊗ – SEE FIG. C1 THROUGH C3 FOR CONNECTION AT MODULE.

## SCG-1200-S-06-06 CARAVAN CONTROL SYSTEM WIRING DIAGRAM

- **Up to 6 space heating modules**
- **Up to 6 stages**

**SYSTEM CONTROLLER SC1200**

SC1200 panel is factory equipped for 6 stage operation. To change the number of operating stages the appropriate resistor must be installed in the SC1200 panel, ***on the microprocessor control***, across terminals 7 and 8. Resistors for 1 through 5 stages are shipped with the SC1200 panel. Resistors for 7 through 10 stages are shipped with the SC1200 panel. See Table C3.

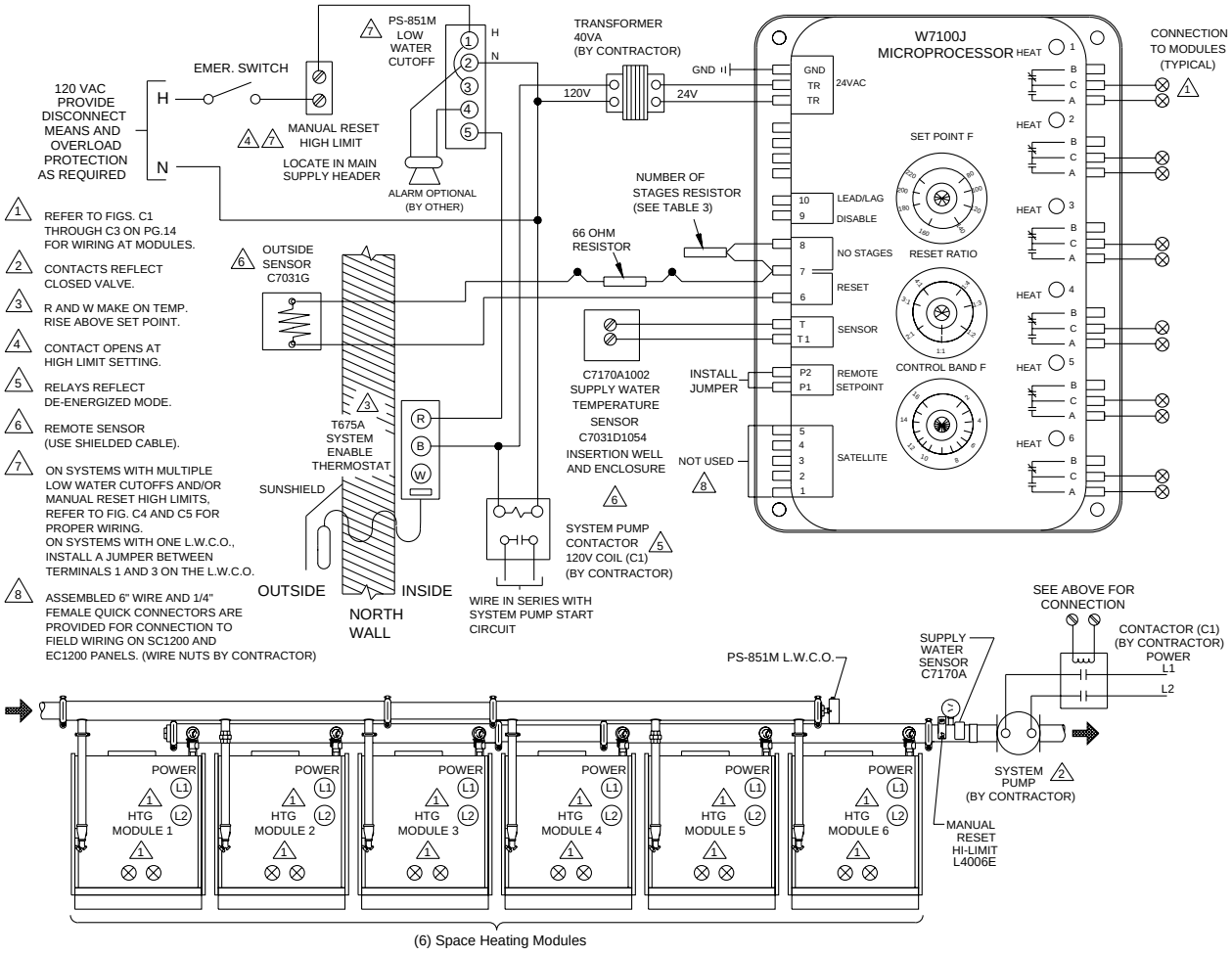
For proper control settings refer to Tables C1 and C2.

Microprocessor control has a two minute time delay between stages. For rapid testing and troubleshooting, the control may be temporarily sped up by using a TP1 test plug kit. Order Slant/Fin part number 411006 (Honeywell part number 4074EDJ).

This control is equipped with automatic lead/lag which constantly rotates the boiler firing order to ensure even wear. The automatic lead/lag function can be disabled by installing a jumper in the SC1200 panel, **on the microprocessor control**, across terminals 9 and 10.

**IMPORTANT**

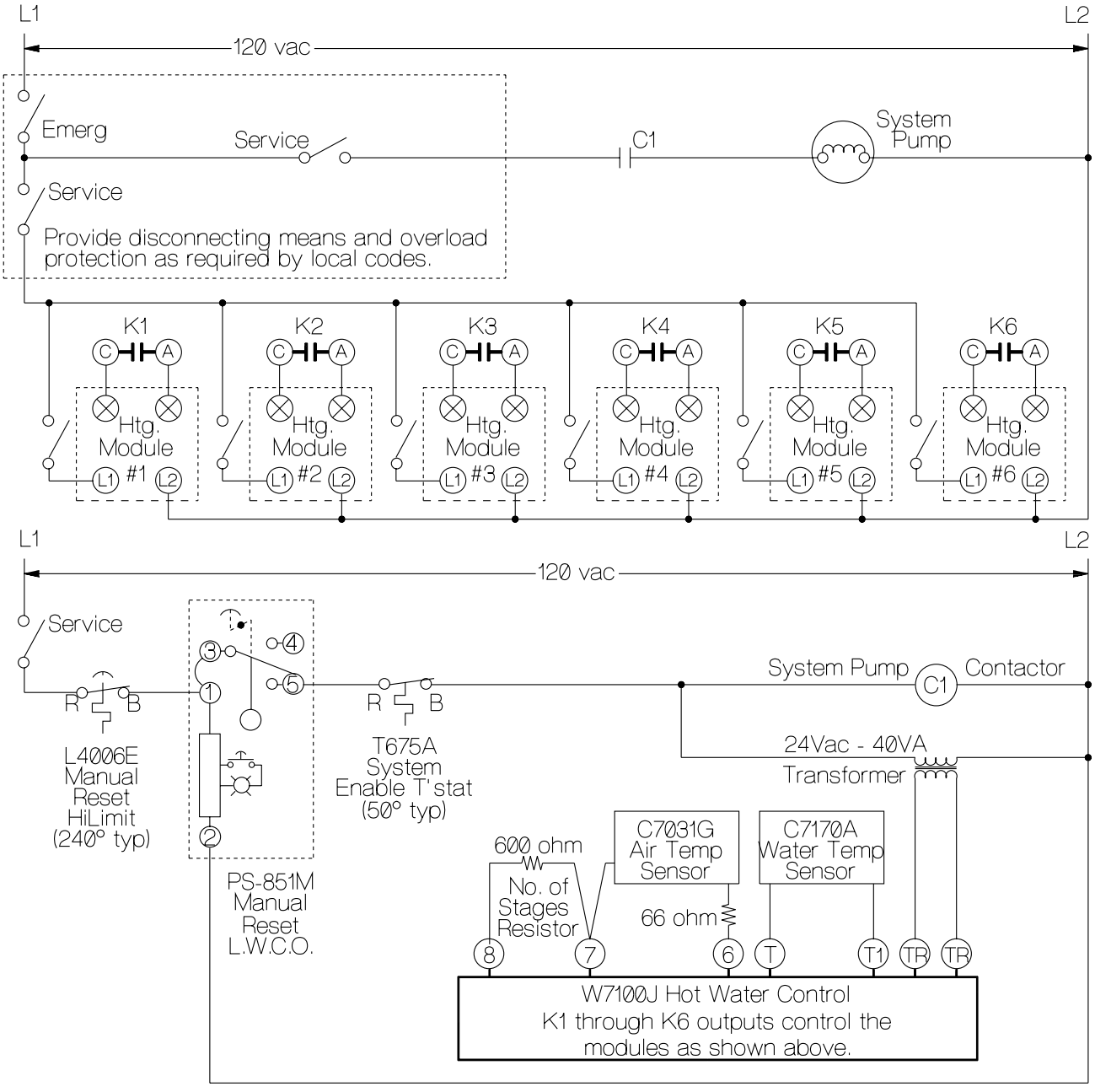
For more detailed information, refer to the manufacturer's data packed with each component.




**Sequence of operation - SCG1200**

Space heating only

When outdoor temperature falls below the setting of the system enable temperature control (T675A), the system is enabled. The 1200 series control system energizes the necessary modules to maintain sufficient supply water temperature based upon outdoor air temperature demand. As outdoor air temperature changes, the system will automatically increase or decrease the number of operating modules until supply water temperature meets outdoor air temperature demand. The control system also operates the boilers with automatic lead/lag, ensuring equal run-time for each boiler. If desired, the automatic lead/lag can be disabled by installing a jumper, on the microprocessor control, across terminals 9 and 10.

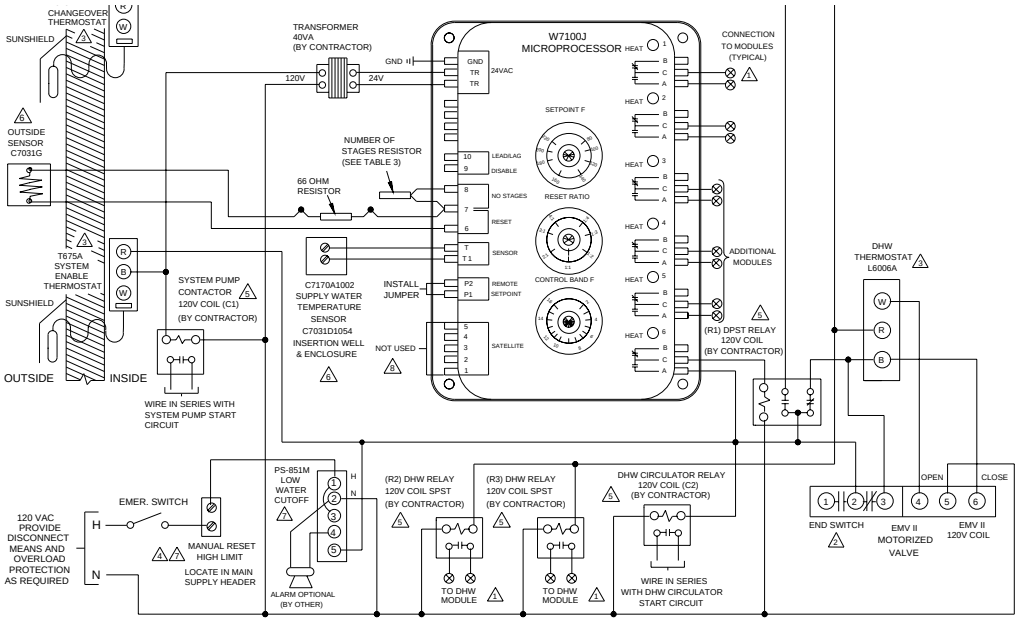


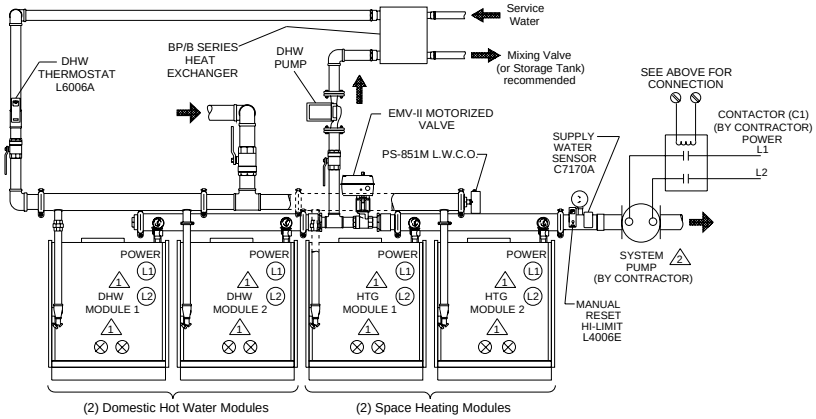

⊗ – SEE FIG. C1 THROUGH C3 FOR CONNECTION AT MODULE.

**SCG-1200-D-06-05 CARAVAN CONTROL SYSTEM WIRING DIAGRAM**

- **Domestic hot water and space heating**
- **Up to 6 space heating modules**

1. REFER TO FIGURES C1 THROUGH C3 PAGE 14 FOR WIRING TO MODULE AT MODULES.
2. CONTACTS REFLECT CLOSED VALVE.
3. R AND W MAKE ON TEMPERATURE RISE ABOVE SET POINT.
4. CONTACT OPENS AT HIGH LIMIT SETTING.
5. RELAYS REFLECT DE-ENERGIZED MODE.
6. REMOTE SENSOR (USE SHIELDED CABLE).
7. ON SYSTEMS WITH MULTIPLE LOW WATER CUTOFFS AND/OR MANUAL RESET HIGH LIMITS, REFER TO FIG. C4 AND C5 FOR PROPER WIRING. ON SYSTEMS WITH WITH ONE L.W.C.O., INSTALL A JUMPER BETWEEN TERMINALS 1 AND 3 ON THE L.W.C.O.
8. ASSEMBLED 6" WIRE AND 1/4" FEMALE QUICK CONNECTORS ARE PROVIDED FOR CONNECTION TO FIELD WIRING ON SC1200 AND EC1200 PANELS. (WIRE NUTS BY CONTRACTOR)

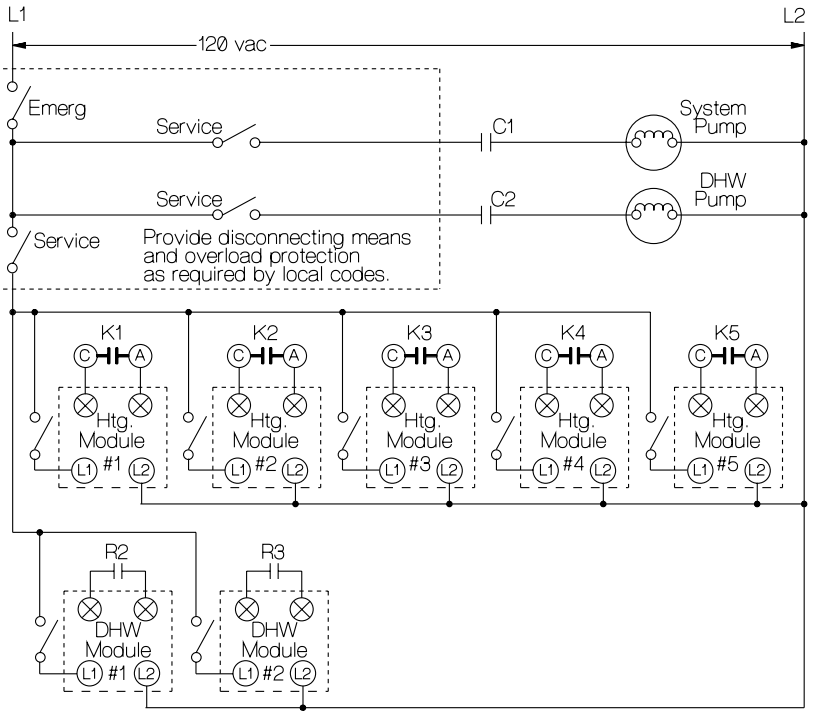


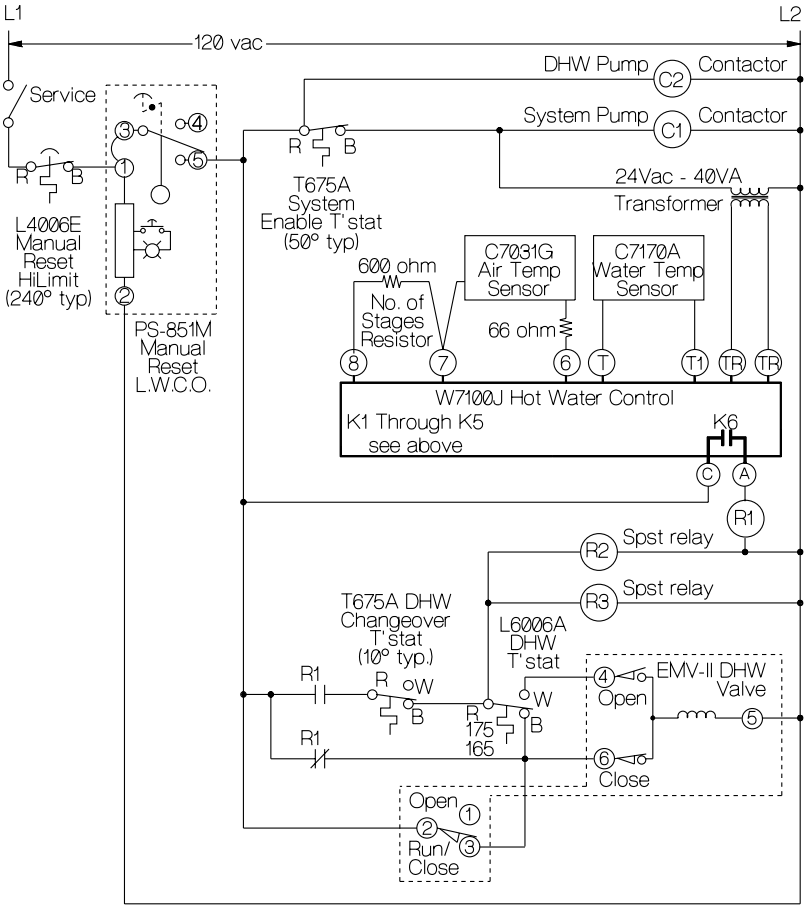




**SEQUENCE OF OPERATION - SCG1200**

**Space heating and domestic hot water**

When outdoor temperature falls below the setting of the system enable temperature control, the space heating system is enabled. The microprocessor control will energize the necessary modules to maintain sufficient supply water temperature based upon outdoor air temperature. As the outdoor temperature changes, the control system will increase or decrease the number of operating modules to meet the supply water temperature required by the outdoor temperature. The modules operate with automatic lead/lag, first on - first off (FOFO), or lead/lag can be disabled to operate first on - last off. When the outdoor temperature falls below the setting of the outdoor DHW Changeover Thermostat, *and* domestic hot water (DHW) is satisfied, *and* stage 6 is energized, the DHW valve opens, allowing the domestic hot water modules to contribute to space heating.



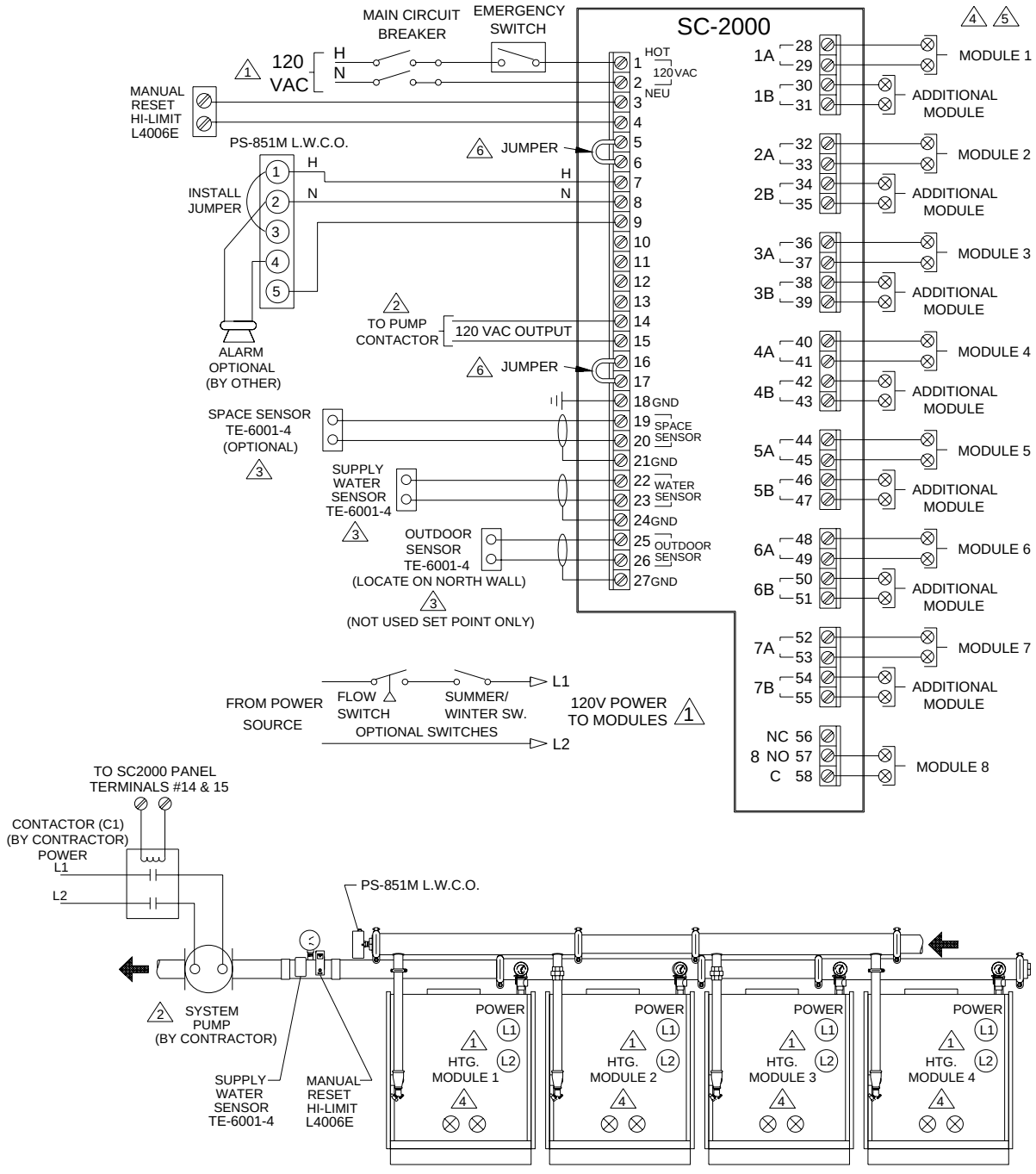




⊗ – SEE FIG. C1 THROUGH C3 FOR CONNECTION AT MODULES.

**SCG-2000-4 CARAVAN CONTROL SYSTEM WIRING DIAGRAM**

- **Space heating**
- **Up to 15 space heating modules**

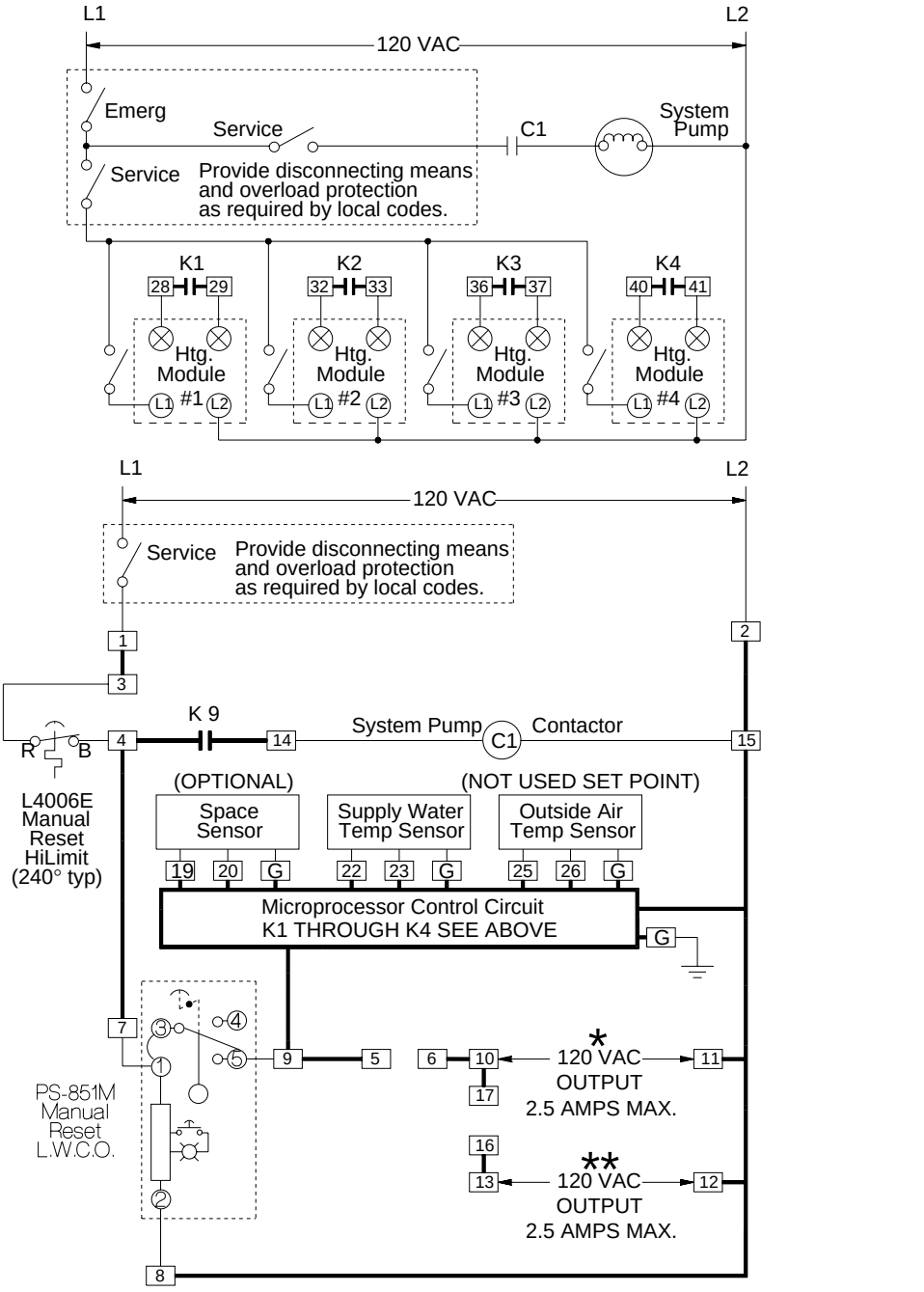
1. PROVIDE DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQUIRED BY LOCAL CODE.
2. SYSTEM PUMP FOR HOT WATER SYSTEM ONLY.
3. SHIELDED CABLE IS RECOMMENDED WHEN WIRING SENSORS.
4. REFER TO FIGURE C1 THROUGH C3 ON PAGE 14 FOR WIRING AT MODULES.
5. 4 SPACE HEATING MODULES SHOWN; UP TO 15 MODULES OF SPACE HEATING MODULES CAN BE CONNECTED.
6. WHEN TERMINALS 5 AND 6 ARE JUMPED THERE IS A 120V OUTPUT ON TERMINALS 10 AND 11. WHEN TERMINALS 5 AND 6 AND 16 AND 17 ARE JUMPED THERE IS A 120V OUTPUT ON TERMINALS 12 AND 13. 2.5 AMPS PER TERMINALS 10 AND 11 AND 12 AND 13 TOTAL 5 AMPS MAX.




**SEQUENCE OF OPERATIONS - SCG2000**

**Space heating only**

When outdoor temperature falls below the outdoor start temperature setting, the system is enabled. The microprocessor control will energize the necessary modules to maintain sufficient supply water temperature based upon outdoor air temperature. As the outdoor temperature changes, the control system will increase or decrease the number of operating modules to meet the supply water temperature required by the outdoor temperature. The modules operate with automatic lead/lag, first on - first off (FOFO) or, after all boilers are off, stage 1 is first on - then FOFO. A space sensor can be installed (usually with most non-zoned systems). This modifies the selected supply water temperature, to accurately meet the space temperature selected. The control has built-in set-back programming capability.




⊗ – SEE FIG. C1 THROUGH C3 FOR CONNECTION AT MODULE.

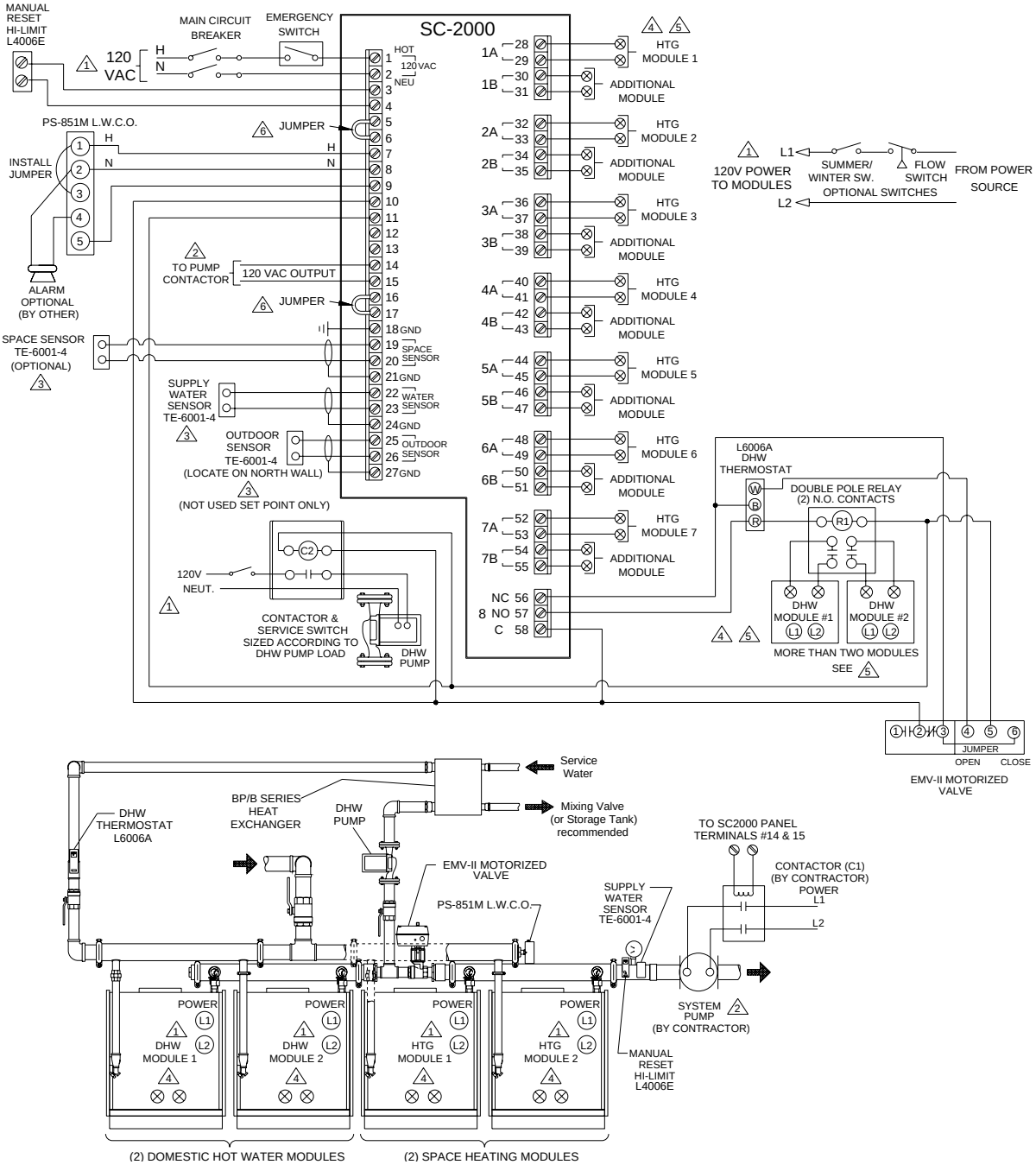
* – 120V OUTPUT WHEN TERMINALS (5 AND 6) ARE JUMPED.

** – 120V OUTPUT WHEN TERMINALS (5 AND 6) AND (16 AND 17) ARE JUMPED.

**SCG-2000-D-4 CARAVAN CONTROL SYSTEM WIRING DIAGRAM**

- **Domestic hot water and space heating**
- **Up to 14 space heating modules**

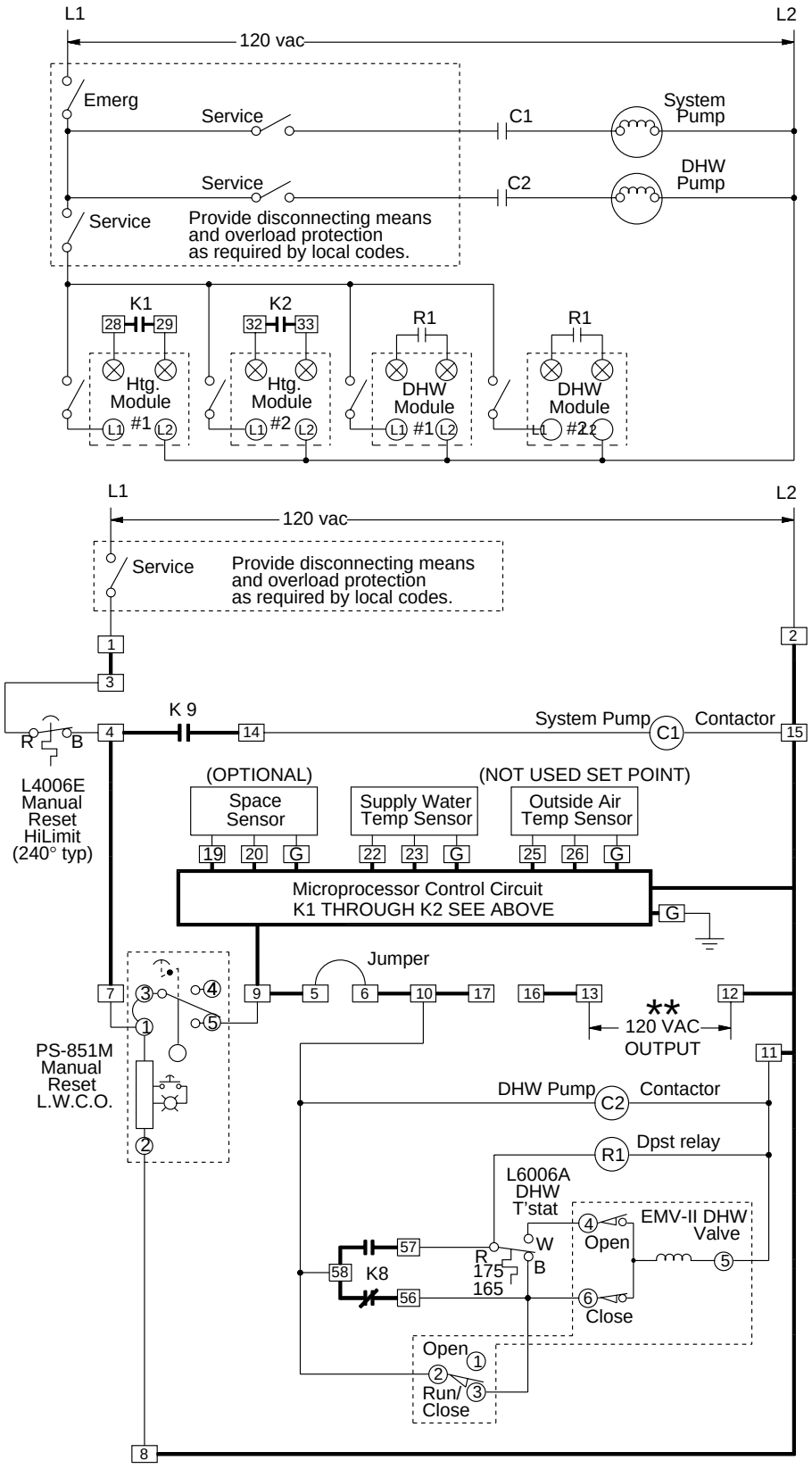
1. PROVIDE DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQUIRED BY LOCAL CODES.
2. SYSTEM PUMP FOR HOT WATER SYSTEM ONLY.
3. SHIELDED CABLE IS RECOMMENDED WHEN WIRING SENSORS.
4. REFER TO FIGURE C2 AND C3 ON PAGE 14 FOR WIRING AT MODULES.
5. UP TO 14 SPACE HEATING MODULES CAN BE CONNECTED, TWO DOMESTIC MODULES ARE SHOWN. MORE DOMESTIC MODULES CAN BE ADDED. DHW RELAY OR RELAYS MUST HAVE ONE N.O. CONTACT PER MODULE.
6. WHEN TERMINALS 5 AND 6 ARE JUMPED THERE IS A 120V OUTPUT ON TERMINALS 10 AND 11. WHEN TERMINALS 5 AND 6 AND 16 AND 17 ARE JUMPED THERE IS A 120V OUTPUT ON TERMINALS 12 AND 13. 2.5 AMPS PER TERMINALS 10 AND 11 AND 12 AND 13 TOTAL 5 AMPS MAX.




**Sequence of operation - SCG2000**

Space heating and domestic hot water

When the outdoor temperature falls below the outdoor start temperature setting, the space heating system is enabled. The microprocessor control will energize the necessary modules to maintain sufficient supply water temperature based upon outdoor air temperature. As the outdoor temperature changes, the control system will increase or decrease the number of operating modules to meet the supply water temperature required by the outdoor temperature. The modules operate with automatic lead/lag, first on - first off (FOFO) or, after all boilers are off, stage 1 is first on - then FOFO. With all space heating stages energized, if the space load exceeds the stages capacity, *and* domestic hot water is satisfied, the domestic hot water valve will open, allowing the domestic water modules to contribute to space heating. A space sensor can be installed (usually with most non-zoned systems). This modifies the selected supply water temperature, to accurately meet the space temperature selected. The control has built-in set-back programming capability.




⊗ – SEE FIG. C1 THROUGH C3 FOR CONNECTION AT MODULE.

** – 120V OUTPUT WHEN TERMINALS (5 AND 6) AND (16 AND 17) ARE JUMPED.

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