

CONDENSING TANKLESS GAS WATER HEATER



Application Manual

Models

RTGS199N1 / RTGS199X1
RTGR199N1 / RTGR199X1•
Natural Gas (NG) / Propane Gas (LP)



Low NOx Approved
by SCAQMD
14ng/l or 20ppm
(Natural Gas Only)



⚠ WARNING

Follow each appliance's instruction manual precisely.

Installation and service must be performed by a trained and certified installer, service agency or the gas supplier.

Application drawings in this manual are conceptual only and do not purport to address all design, installation, code, or safety considerations.

The diagrams in this manual are for reference use by code officials, designers and licensed installers. It is expected that installers have adequate knowledge of national and local codes, as well as accepted industry practices, and are trained on equipment, procedures, and applications involved. Drawings are not to scale.

Refer to the appliance and accessory installation manuals for additional detailed information.

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SECTION 1 Safety Regulations

1.1 Safety Symbols

 **WARNING**

Warnings in this document are identified by a warning triangle printed against a grey background. Keywords at the start of a warning indicate the type and seriousness of the ensuing risk if measures to prevent the risk are not taken.

For safety symbols, 'DANGER', 'WARNING', CAUTION' are indicated and the definitions for these terms are as follow:

 **DANGER**

Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury. This signal word is limited to the most extreme situations.

 **WARNING**

Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

 **CAUTION**

Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It is also used to alert against unsafe practices and hazards involving only property damage.

1.2 Safety

PLEASE READ SAFETY PRECAUTIONS BEFORE INSTALLATION.

 **WARNING**

These instructions are intended as an aid to qualified licensed service personnel for proper installation, adjustment and operation of this unit. Read these instructions thoroughly before attempting installation or operation. Failure to follow these instructions may result in improper installation, adjustment, service or maintenance and possibly resulting in fire, electrical shock, property damage, personal injury or death.

 **WARNING**

Disconnect all power to the unit before starting any service and maintenance. Failure to do so could cause severe electrical shock resulting in personal injury or death.

SECTION 2 Introduction

This manual is used to present some of the most common applications for the appliance. Drawings are shown with both piping and corresponding electrical connections where applicable. Field supplied equipment shown in this manual does not represent any one manufacturer or specific model. This manual does not cover all potential installation practices and piping techniques possible when installing water heating appliances. It is the responsibility of the professional installer to determine the best solution for the application, as well as abide by local building codes.

NOTICE

In this manual concept drawings are used to show common applications, and do not cover all safety, design, or installation considerations. Additional safety and/or auxiliary equipment may be needed. Reference concept drawings are for use by officials, designers and professional installers. Installers must have adequate knowledge of best industry practices, procedures, and applications involved. It is the responsibility of the professional installer to ensure that the installation abides with local building codes.

This manual covers the most common system application however it is not the intention of this manual to cover all potential applications as possibilities are nearly endless. If an application is not covered within this manual and questions surrounding best practices arise please contact the manufacturer with specific application needs.

This manual is not to be used in place of the installation and operation manuals included with the appliance. For a copy of the applicable Installation and operation materials a copy can be downloaded from the manufacturer's website. All manuals/specifications are subject to change.

NOTICE

Installation must conform with local codes or, in the absence of local codes, the National Fuel Gas Code ANSI Z223.1/NFPA 54.

In Canada: Installation must conform with CGA B149.(1,2) INSTALLATION CODES and/or local installation codes.

SECTION 3 Water Heater Sizing and Specifications

This section describes sizing rules for the RTGS and RTGR series water heaters from Bradford White Corporation and provides a general overview to the specification sheets and model. More detailed information is contained in the installation manuals.

Download manuals at www.bradfordwhite.com

3.1 Sizing for Specific Application or Loads

Peak Demand Sizing by Flow rate x Rise

The peak demand is the product of the flow rate and rise. Flow rate is the number of gallons per minute being demanded. The rise is the difference between the demanded set point and the inlet temperature. If inlet temperature and setpoint cannot be determined, refer to the fixture count method and average ground water temperature map from figure 1.

Determining Peak Demand Flow:

- Determine which fixtures will be used simultaneously. The total flow rate is the peak demanded flow. Determine the flow rate of each of these fixtures and total them.
- To determine flow rate determine the length of time required to fill a known volume. Using the fill time and the container volume and the equation below calculate peak flow rate. (Example: 20 seconds to fill 1 gallon container = 3 GPM)

$$\text{Flow rate(GPM)} = \frac{\text{Volume(gallons)}}{\text{Fill time(sec)}} \times 60$$

Counting Fixtures to determine Peak Demand Flow:

- Each Sink will flow ~1 GPM.
- Each Shower will flow ~ 2 GPM.
- Each Bath/Garden tub will flow 3.5-4.5 GPM
- Total all simultaneous flow rates for peak demand flow.

Determining Rise:

Using a thermometer run a cold water fixture until the room temperature water is purged from the cold water line. Rise is the difference between the demanded setpoint and this cold water temperature. For example if inlet water is 58°F and setpoint is 120°F the rise is 62°F. If supply water temperature cannot be measured refer to the chart on the next page for general ground water temperatures.

Example

$$\text{Peak BTU Demand (BTU/Hr)} = 500 \times \text{Demand Flow(GPM)} \times \text{Rise(}^\circ\text{F)}$$

- Peak Flow is two showers and one sink, 2+2+1 = 5 GPM.
- Supply is 58°F and Setpoint is 120°F, 120°F - 58°F = 62°F
- Peak BTU demand = 500 * 62(°F) * 5(GPM) = 155,000 BTU / hr.

3.2 Specifications

Model Name		RTGS199N1 / RTGS199X1		RTGR199N1 / RTGR199X1		
Gas Input Rate	MAX	199,000 Btu/h				
	MIN	18,000 Btu/h				
	High Elevation	180,000 Btu/h				
Hot Water Capacity	35°F Rise	11.1 Gal/min (42 L/min)				
	45°F Rise	8.7 Gal/min (32.9 L/min)				
	77°F Rise	5.1 Gal/min (19.3 L/min)				
Installation		Indoor / Outdoor Wall Hung (with outdoor vent cap)				
Flue System		Sealed Combustion Direct Vent, Single Vent, Outdoor				
Max Vent Run		2" (60ft) / 3" (150ft) Schedule 40 PVC, CPVC, PP				
Orifice Size	NG (Gas / Needle)	0.330"(8.4mm) / 0.342"(8.7mm)				
	LP (Gas / Needle)	0.259"(6.6mm) / 0.263"(6.7mm)				
Gas Supply Pressure	NG	3.5" WC to 10.5" WC				
	LP	8.0" WC to 14.0" WC				
Manifold Pressure	Gas Type		NG	LP	NG	LP
	Low Fire	2" VENT	0.1" WC	-0.05" WC	0.1" WC	-0.05" WC
		3" VENT	0.1" WC	-0.05" WC	0.1" WC	-0.05" WC
	High Fire	2" VENT	-0.20" WC	-0.30" WC	-0.20" WC	-0.30" WC
3" VENT		-0.20" WC	-0.30" WC	-0.20" WC	-0.30" WC	
Power Supply	Main Supply		120V 60Hz			
	Max Current		Less than 2A			
Power Consumption	Standby		2.7W	2.7W		
	Operation		74W / 188W (with external pump)		188W	
	Anti Freeze		53W	117W		
Ignition System		Direct Electronic Ignition / Automatic Flame Sensing				
Burner System		Premixed Metal Fiber Burner				
Gas Valve System		Air Ratio Valve				
Minimum Flow Activation Flow		0.5 GPM				
Internal Pipe Material		STS 304, Stainless Steel with PPS				
Dimensions		W 17.3" – H 27.6" – D 14.8"				
Weight		78 lbs (35.5 kgs)	85 lbs (38.5 kgs)			
Water Holding Capacity		Under 2 Gallons				
Display Panel		PR-922C	PR-952C			
Water Pressure	MAX	150 psi				
	MIN	15 psi				
Materials	Casing	Cold Rolled Carbon Steel				
	Heat Exchanger	Heat Exchanger : SS 304				
Safety Devices		Flame Sensor, Overheat Cut Off Switch , Gas Leak Detector, Water Leak Detector, Exhaust Temperature Sensor, Water Temperature Sensor				

Temperature

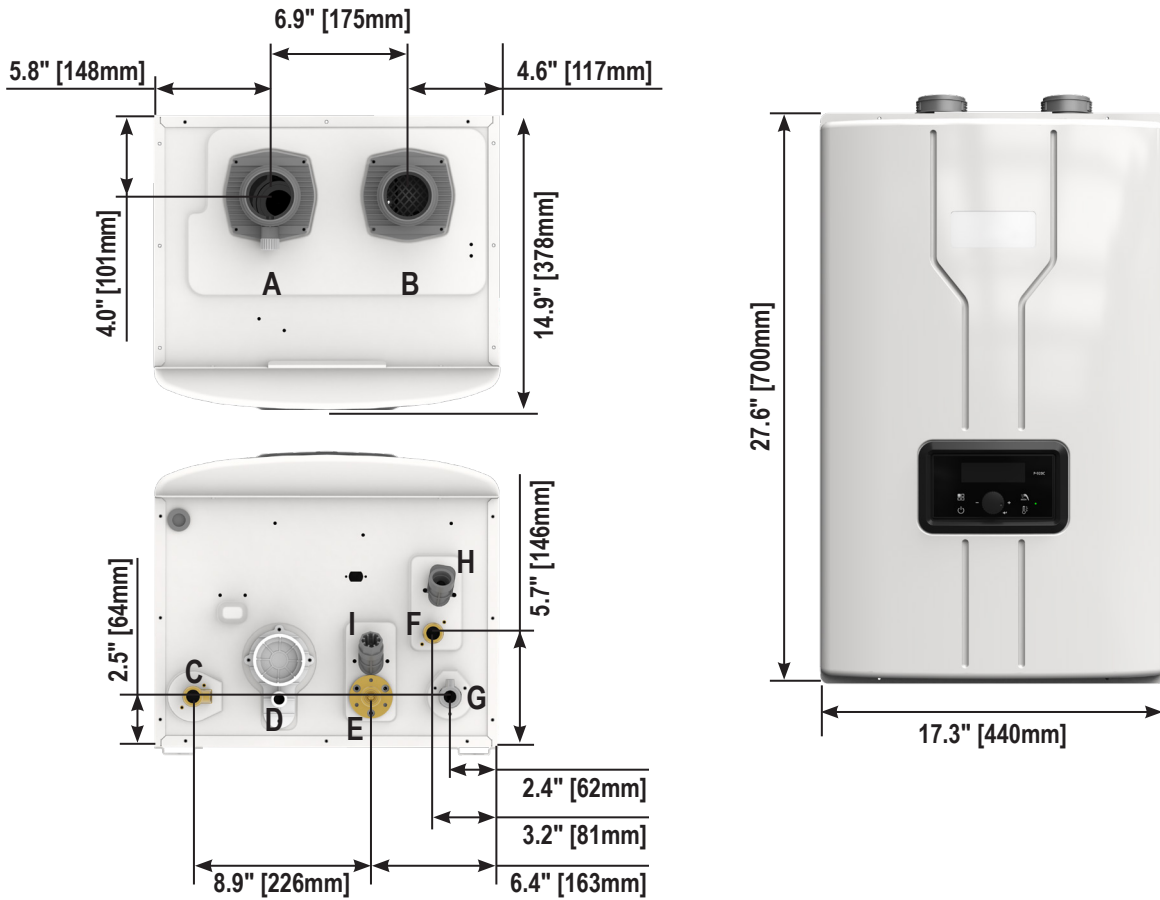
Operating ambient Temperature Range : Range: 14°F to 140°F (-10 to 60°C).

Operating Relative Humidity up to: 90% at 104°F (40°C).

Shipping & Storage Temperature Range of : -4°F to 176°F (-20 to 80°C).

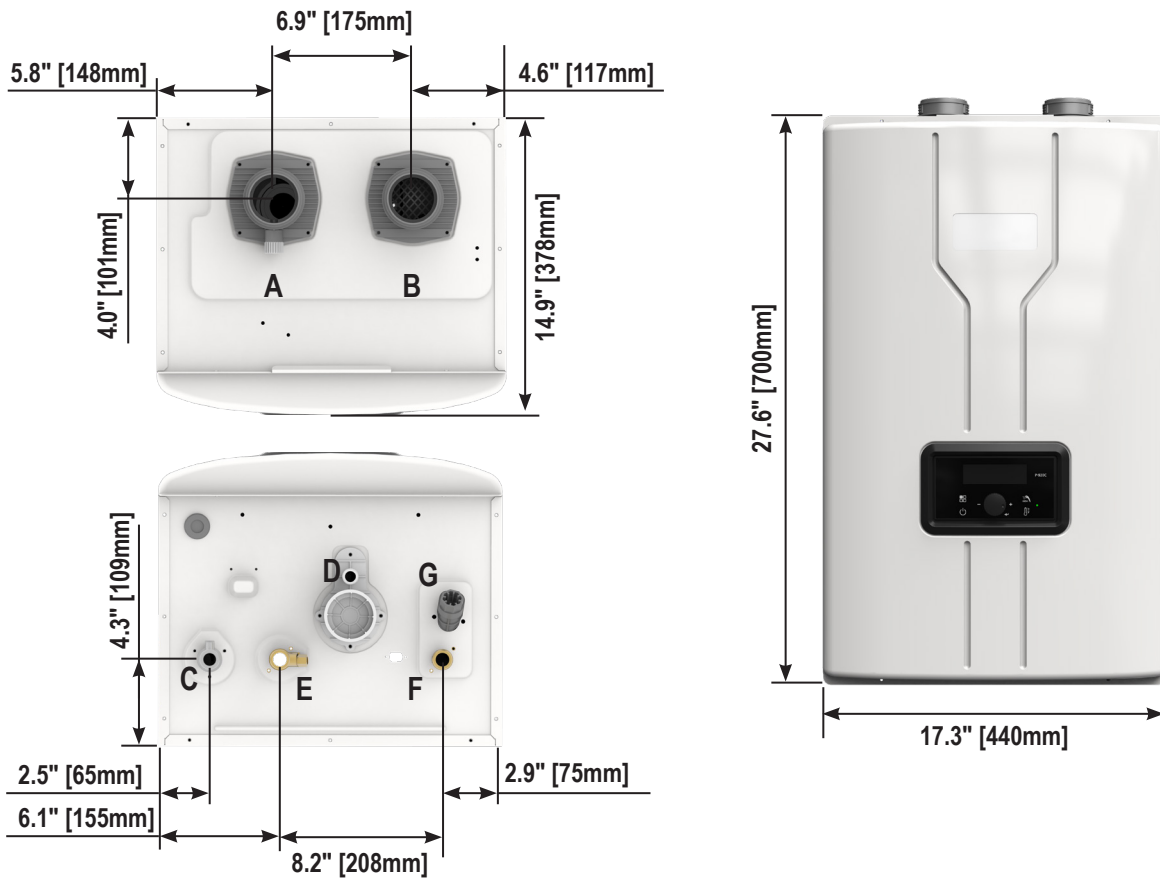
3.3 Dimensions

Dimensions RTGR199N1 / RTGR199X1



	Description	Size
A	Exhaust	2" PVC
B	Air Intake	2" PVC
C	Hot Water	3/4" NPT
D	Condensate	1/2" NPT
E	Recirculation Return Connection	3/4" NPT
F	Cold Water Connection	3/4" NPT
G	Gas	3/4" NPT
H	Cold Water Filter	-
I	Recirculation Return Filter	-

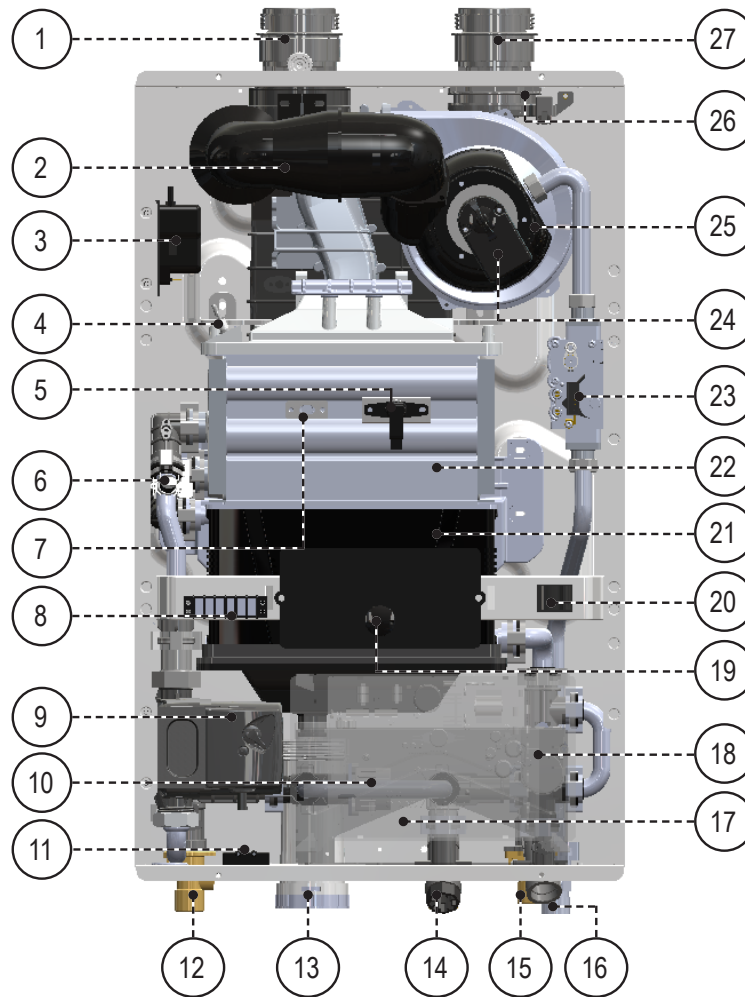
▪ Dimensions RTGS199N1 / RTGS199X1



	Description	Size
A	Exhaust	2" PVC
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E	Hot Water Connection	3/4" NPT
F	Cold Water Connection	3/4" NPT
G	Cold Water Filter	-

3.4 Components

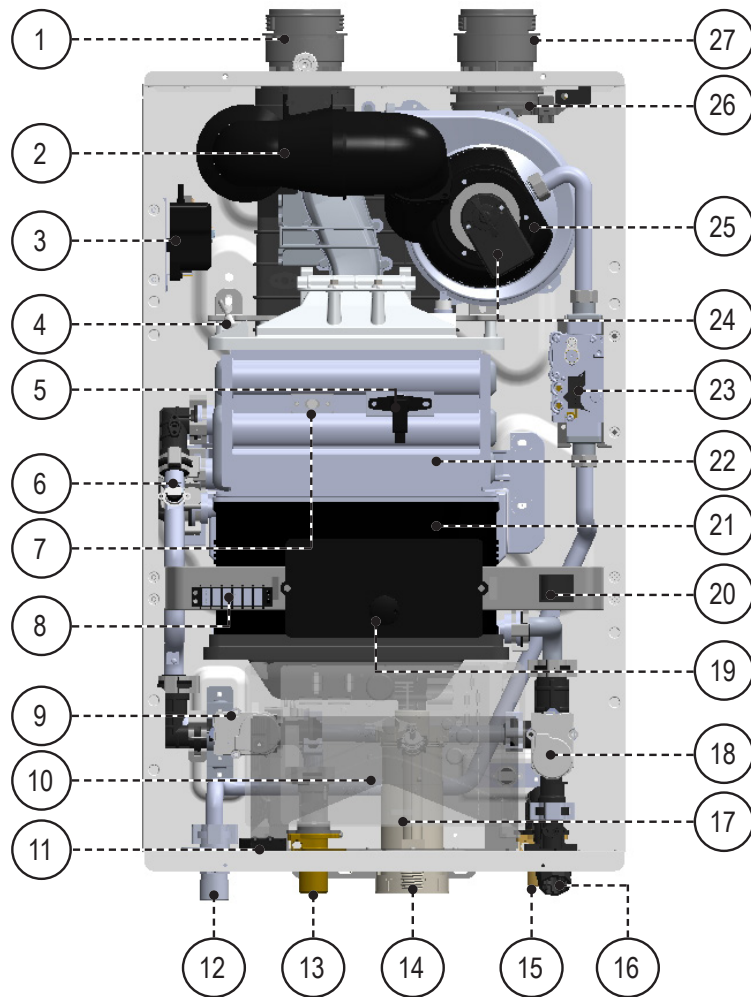
▪ Name of Components RTGR199N1 / RTGR199X1



#	Name of Component
1	Vent Pipe Collar
2	Combustion Air Intake Assembly
3	Ignition Transformer
4	Igniter
5	Flame Detection Sensor
6	High Limit Switch
7	Sight Glass
8	Terminal Port
9	Circulation Water Pump
10	Mixing Valve
11	Water Leak Detector
12	Domestic Hot Water (DHW) Outlet
13	Condensate Trap Cleanout
14	Recirculation Return Water Connector

#	Name of Component
15	Cold Water Inlet
16	Gas Inlet
17	Main Controller
18	Water Adjustment Valve
19	Control Panel
20	Manual Power Switch
21	Secondary Heat Exchanger
22	Primary Heat Exchanger
23	Gas Valve
24	Air Gas Mixture (AGM) Actuator
25	Blower
26	Air Intake Filter
27	Air Intake Collar

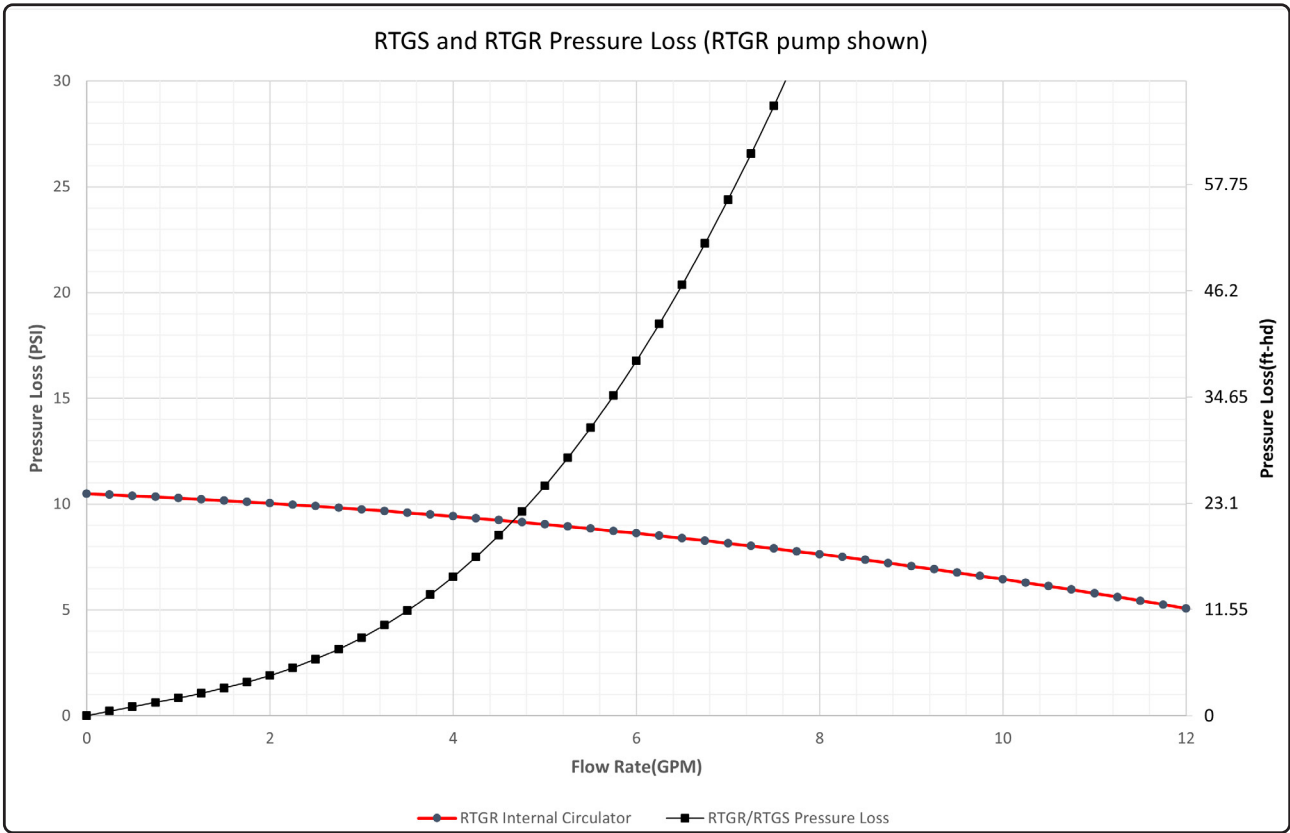
▪ Name of Components RTGS199N1 / RTGS199X1



#	Name of Component
1	Vent Pipe Collar
2	Combustion Air Intake Assembly
3	Ignition Transformer
4	Igniter
5	Flame Detection Sensor
6	High Limit Switch
7	Sight Glass
8	Terminal Port
9	Mixing Valve
10	Main Controller
11	Water Leak Detector
12	Gas Inlet
13	Domestic Hot Water (DHW) Outlet
14	Condensate Trap Cleanout

#	Name of Component
15	Cold Water Inlet
16	Cold Water Filter
17	Condensate Trap
18	Water Adjustment Valve
19	Control Panel
20	Manual Power Switch
21	Secondary Heat Exchanger
22	Primary Heat Exchanger
23	Gas Valve
24	Air Gas Mixture (AGM) Actuator
25	Blower
26	Air Intake Filter
27	Air Intake Collar

3.5 Appliance Pressure Drop & RTGR Pump Performance Curve



Equivalent Power Pumps to RTGR Internal pump:
- Taco 008
- Grundfos UP15-55

3.6 Multi-Unit (Cascade) in Tank Loading Application Pump Selection

RTGS Unit Count	Unit Flow Rate	Total Flowrate (GPM)	Recommended Manifold Size	Grundfos	Taco	Bell and Gossett	Armstrong	Wilo
1	5 Gallons per minute for each Unit	5	3/4"	UPS26-96	009-SF5, 0011-SF4	NRF-36, NRF-45	EE.2B, E9.2B	Top Z 2X40
2		10	1-1/4"	UP26-99	0013-SF3, 2400-20S	NRF-36, NRF-45	EE.2B, E9.2B	Top Z 2X40
3		15	1-1/2"	UPS26-150, UPS32-160	2400-45S, 133B	PL-36	EE.2B, E9.2B	Top Z 2X40
4		20	1-1/2"	UPS26-150, UPS32-160	2400-45S, 133B	PL-55, PDB-40	E9.2B, E23.2B	Top Z 2X40
5		25	1-1/2"	UPS26-150, UPS32-160	2400-45S, 133B	PL-55, PDB-40	E23.2B	Top Z 2X40
6		30	2"	UPS32-160, UPS 40-160	2400-50S, 133B	PL-55, PDB-40	E23.2B	Top Z 2X40
7		35	2"	UPS32-160, UPS 40-160	133B	PDB-40	E23.2B, E22.2B, H64B	Top Z 2X40
8		40	2"	UPS32-160, UPS 40-160	133B	PDB-40	E23.2B, E22.2B, H64B	Top Z 2X40
9		45	2-1/2"	UPS32-160, UPS 40-160	133B	PDB-40	E23.2B, E22.2B, H64B	Top Z 2X40
10		50	2-1/2"	UPS32-160, UPS 40-160	133B	PDB-40	E22.2B, H67B	Top Z 2X40
11		55	2-1/2"	UPS 40-160	133B	PDB-40	E22.2B, H67B	Top Z 2X40
12		60	2-1/2"	UPS 40-160	133B		H67B	Top Z 2X40

RTGR199 and RTGS199(199,000 BTU/hr)									
Flow (GPM)	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0
Loss(PSI)	0.84	1.31	1.90	2.67	3.68	4.96	6.57	8.53	10.87
Loss(ft)	1.94	3.02	4.39	6.17	8.50	11.46	15.17	19.70	25.10
Temperture Rise(°F)	>150°F	>150°F	>150°F	>150°F	129.26°F	110.79°F	96.94°F	86.17°F	77.55°F
Temperature Rise(°C)	>83.33°C	>83.33°C	>83.33°C	>83.33°C	71.81°C	61.55°C	53.86°C	47.87°C	43.09°C

RTGR199 and RTGS199(199,000 BTU/hr)								
Flow (GPM)	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0
Loss(PSI)	13.61	16.77	20.36	24.38	28.83	33.70	38.97	44.62
Loss(ft)	31.44	38.74	47.03	56.32	66.60	77.84	90.02	103.08
Temperature Rise(°F)	70.5°F	64.63°F	59.66°F	55.4°F	51.7°F	48.47°F	45.62°F	43.09°F
Temperature Rise(°C)	39.17°C	35.9°C	33.14°C	30.78°C	28.72°C	26.93°C	25.34°C	23.94°C

SECTION 4 Single-Unit Applications

4.1 Infiniti GR Modes and Piping Diagrams (RTGR199N1, RTGR199X1)

Applications shown in this section are for single appliances. If cascading is required refer to Section 5 Multi-unit Applications (Cascade).

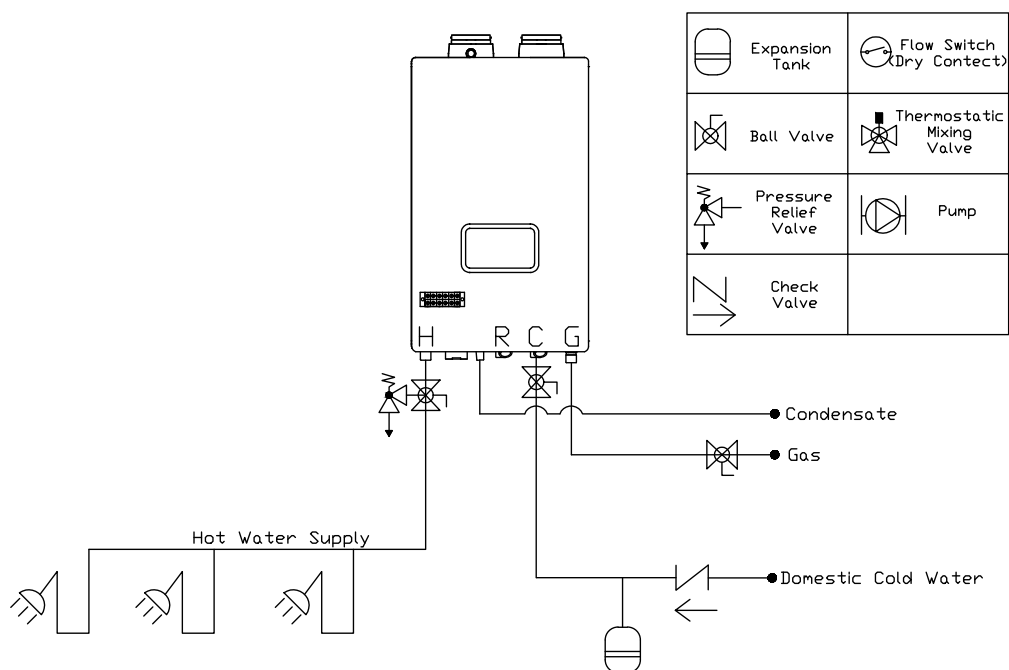
Mode	Description	Setting	Requirement		Performance		
		11:RC	Dedicated Return Line	Accessory	Wait Time Water Savings	Energy Savings	Hot Water Temperature
No Recirculation	Recirculation Pump remains Idle.	OFF	No	-	-	-	-
Internal	Hot water circulates within the appliance, No return line needed.	Itnl	No	-	Better	Better	Better
External	Hot water circulates within the house using external return line.	Etnl	Yes	-	Best	Better	Best
On Demand Title 24	External recirculation when demand button is pressed.	tt24	Yes	O	Better	Best	Best
Crossover	Hot water circulates within the house using 3rd party bypass valve.	CrOS	No	O	Best	Good	Warm

* Recirculation is activated by Timer [Auto / Manual].

Recirculation timer setting can be changed by customer's own desire time.
Auto (self learning mode) function can be selected by customer's need.

No Recirculation Mode, Internal Recirculation Mode

1. Only POTABLE water may be plumbed through the water heater.
2. The water heater cannot be used for space heating applications.
3. Expansion tank is required if a backflow preventer is installed.










Recirculation Mode

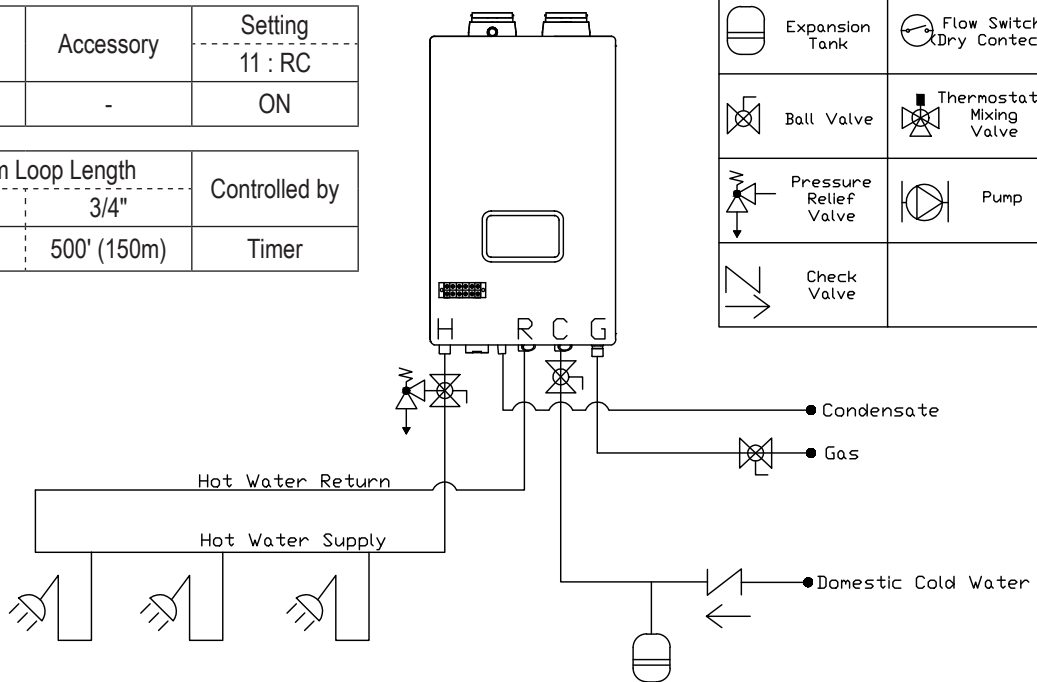
[External Mode]

- Provides most comfortable option. Maintains consistent hot water availability during specified times.
- Timer can be manually customized or programmed to automatically learn daily usage patterns.
- Ability to optimize by using Installer Mode function 3: RT to adjust loop temperature for maximum comfort and safety.

Dedicated Return Line	Accessory	Setting
YES	-	11 : RC ON

Maximum Loop Length		Controlled by
1/2"	3/4"	
200' (60m)	500' (150m)	Timer

	Expansion Tank		Flow Switch (Dry Contact)
	Ball Valve		Thermostatic Mixing Valve
	Pressure Relief Valve		Pump
	Check Valve		



The recirculation pipe must be installed in the field in order to apply the 'External Mode'.
This mode allows the water heater recirculation pipes to be warmed up and serving as the freeze protection function.









Recirculation Mode

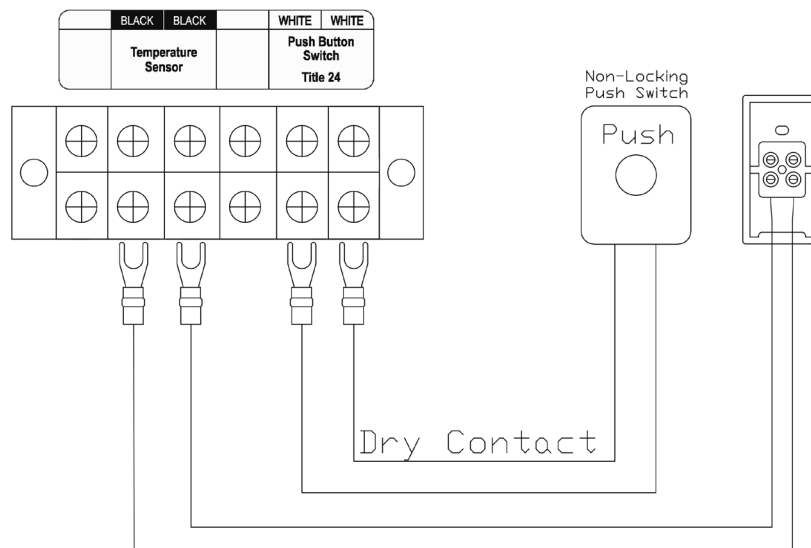
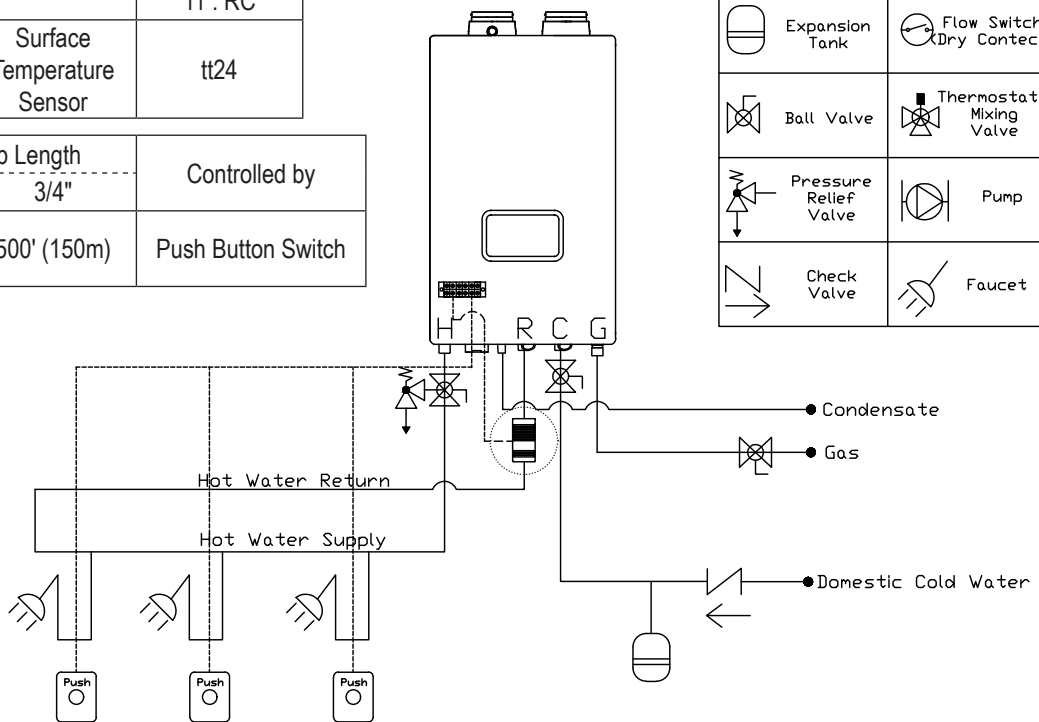
[On Demand(tt24) Mode]

- Provides best energy savings option
- Designed to meet California Title 24 requirements.
- Recirculation will only operate when the push button switch is pressed. Hot water will not be available immediately.
- Built-in timer function is disabled
- Will start circulation pump on-demand to purge cold water from the water lines and replace with hot water.
- Pump will stop operating once hot water has successfully reached 102F at the installed temperature sensor.
- Do not repeatedly press on-demand button. On-demand function will not operate if the water in the line is already warm.

Dedicated Return Line	Accessory	Setting
YES	Surface Temperature Sensor	11 : RC tt24

Maximum Loop Length	Controlled by
1/2" 3/4"	
200' (60m) 500' (150m)	Push Button Switch

	Expansion Tank		Flow Switch (Dry Contact)
	Ball Valve		Thermostatic Mixing Valve
	Pressure Relief Valve		Pump
	Check Valve		Faucet











Recirculation Mode

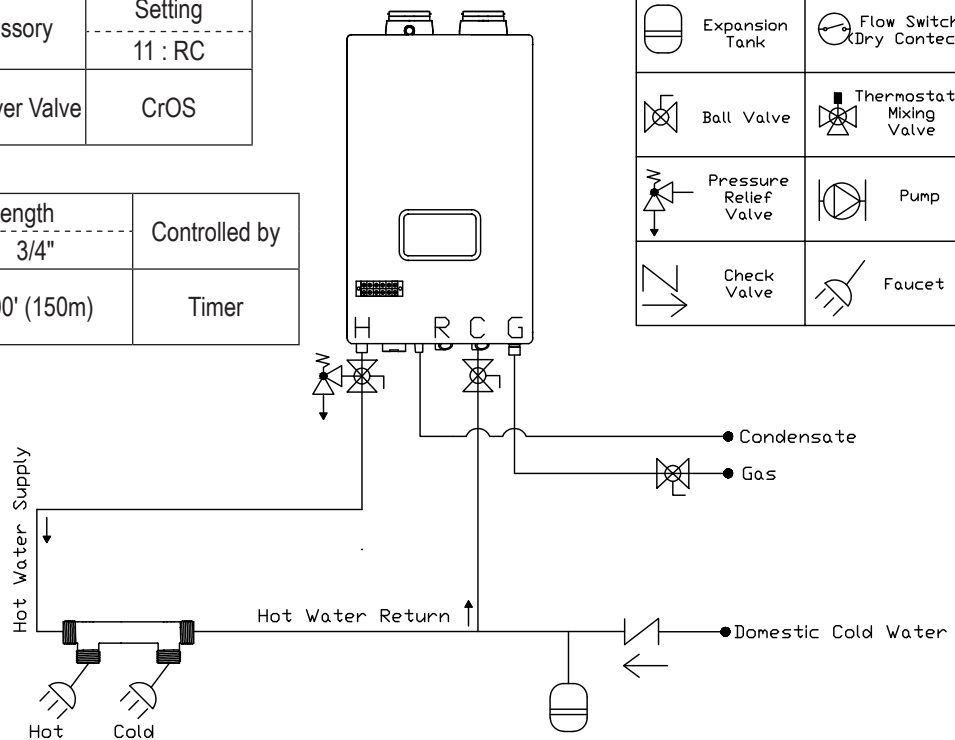
[Crossover(CrOS) Mode]

- Provides recirculation option for homes without a dedicated return line by utilizing the cold water line as a return line.
- Timer can be manually customized.
- In order to prevent hot water from being supplied into the cold water line, the thermal element in the crossover valve will close at 95F. As a result, hot water may not be available at all times (only warm water).

Dedicated Return Line	Accessory	Setting 11 : RC
NO	Crossover Valve	CrOS

Maximum Loop Length	Controlled by
1/2" 3/4"	
200' (60m) 500' (150m)	Timer

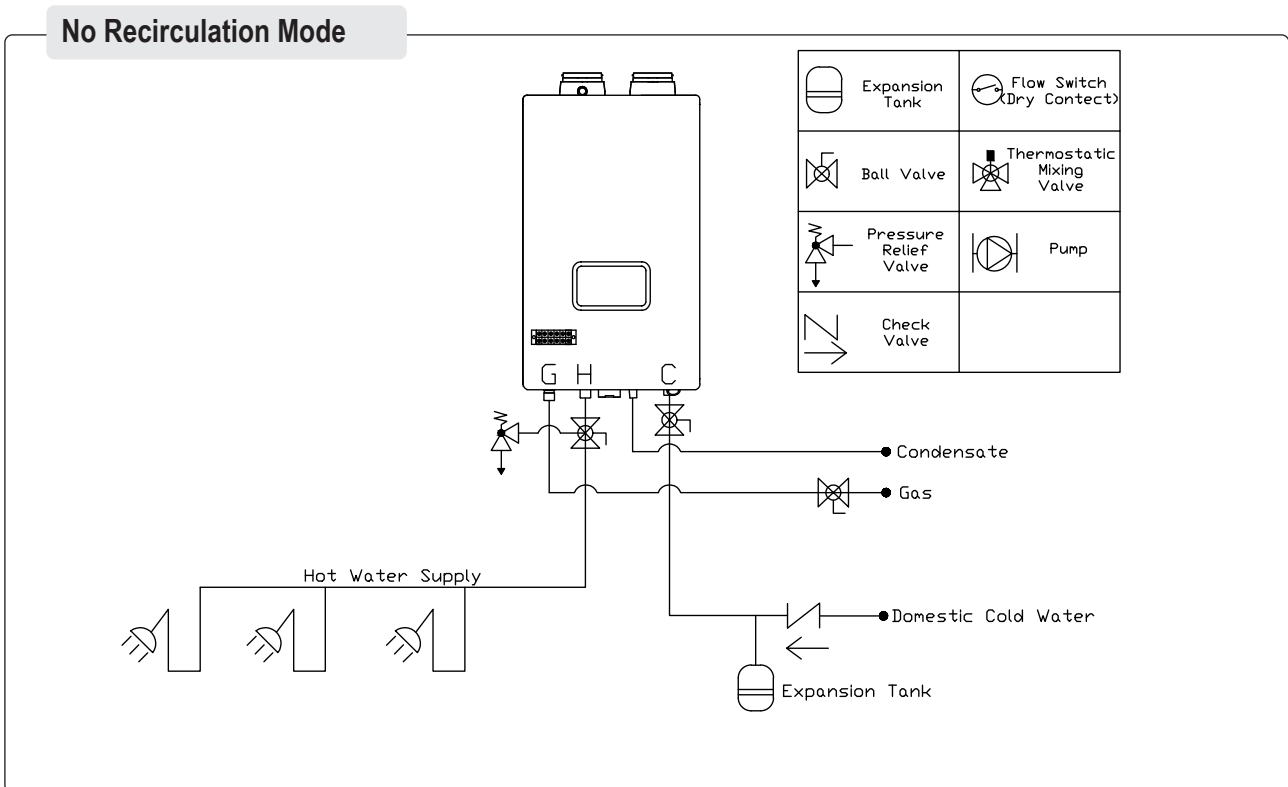
	Expansion Tank		Flow Switch (Dry Contact)
	Ball Valve		Thermostatic Mixing Valve
	Pressure Relief Valve		Pump
	Check Valve		Faucet



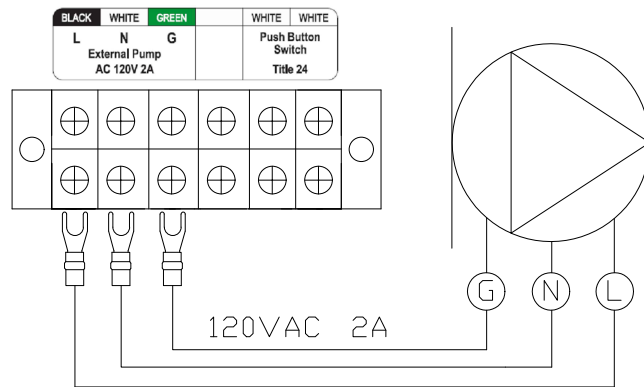
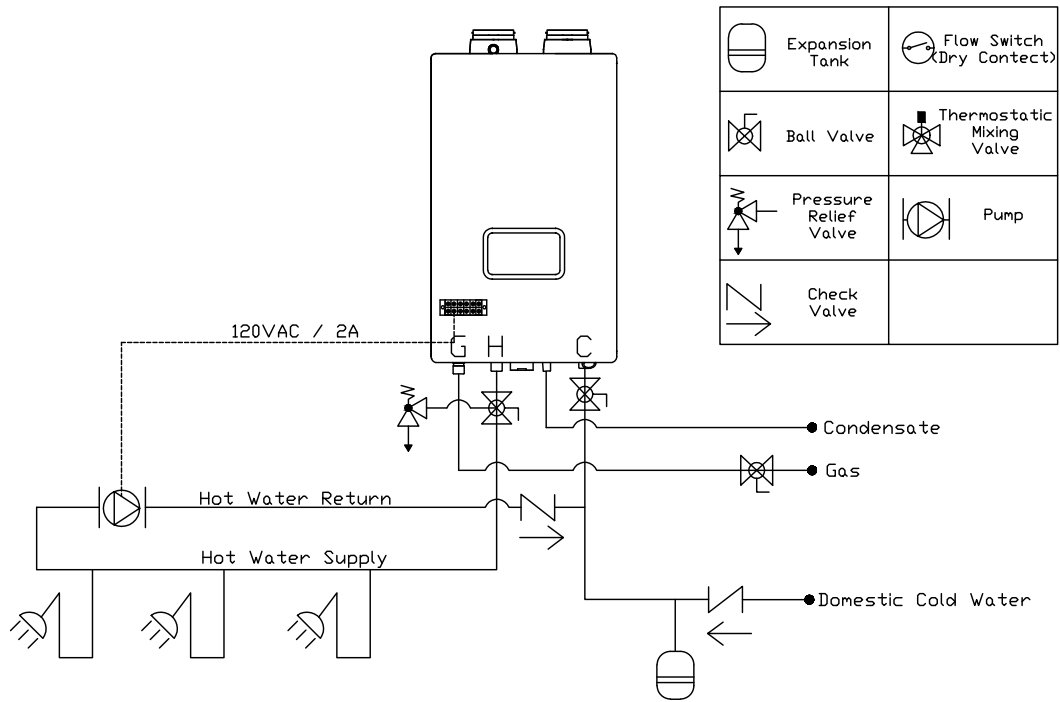
4.2 Infiniti GS Modes and Piping Diagrams (RTGS199N1, RTGS199X1)

Mode	Description	Setting	Requirement		Performance		
		11:RC	Dedicated Return Line	Accessory	Wait Time Water Savings	Energy Savings	Hot Water Temperature
No Recirculation	Heat water as draws occur, no recirculation occurs	OFF	No	-	-	-	-
Pulse*	Unit controls an External pump with a dedicated return	PuLS	No	-	Best	Better	Best
TT24* (Title 24)	Only operates recirculation line with a push of a button.	tt24	No	O	Better	Best	Warm
On Demand*	Only operates recirculation line with a push of a button.	OndE	No	O	Better	Good	Best

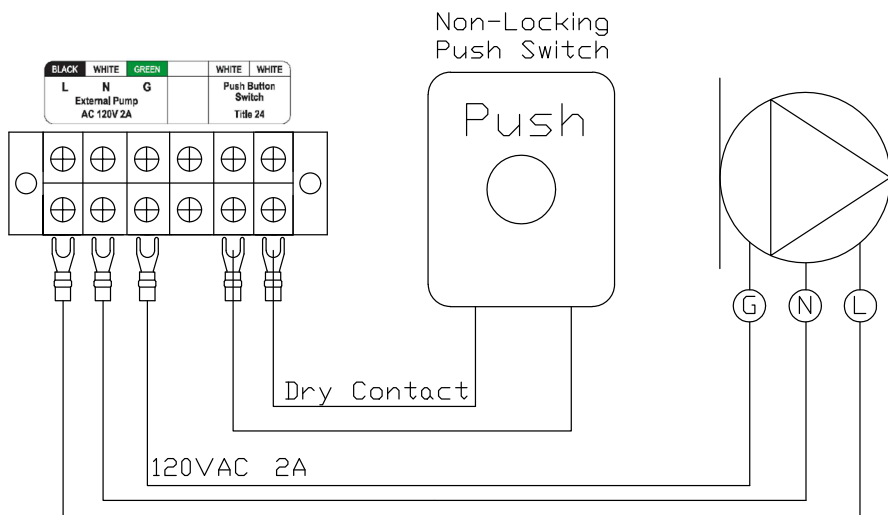
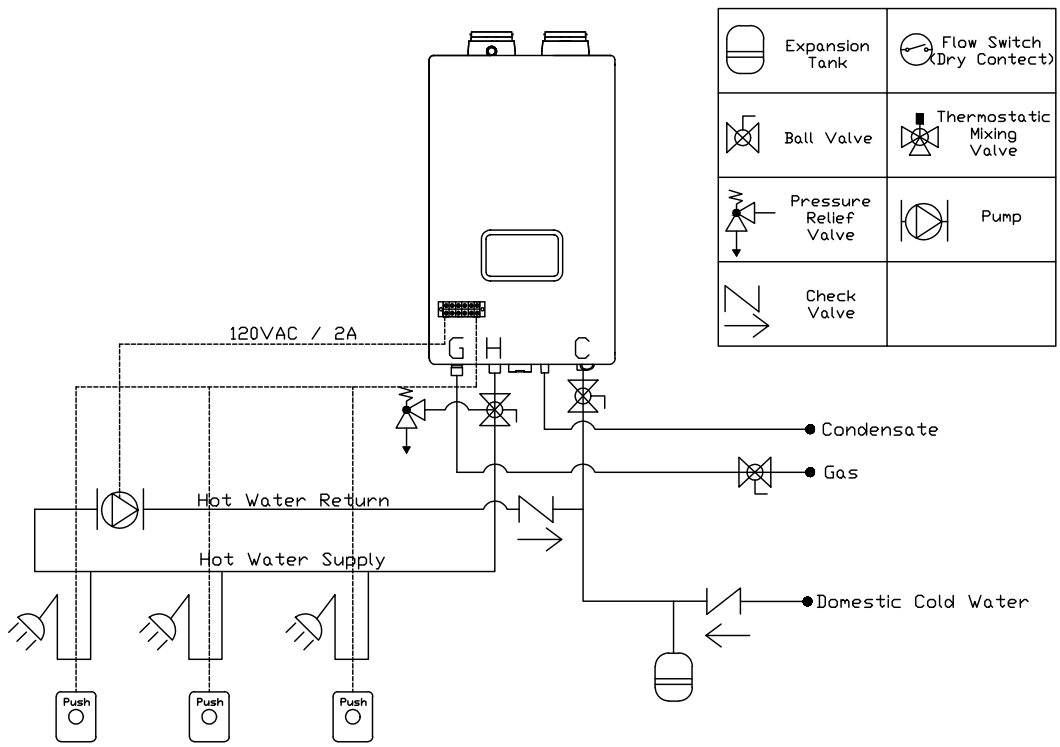
*Models not equip with a built-in pump will require a field supplied circulator to be installed for use with recirculation modes. See sections 3.5 & 3.6



Pulse Mode

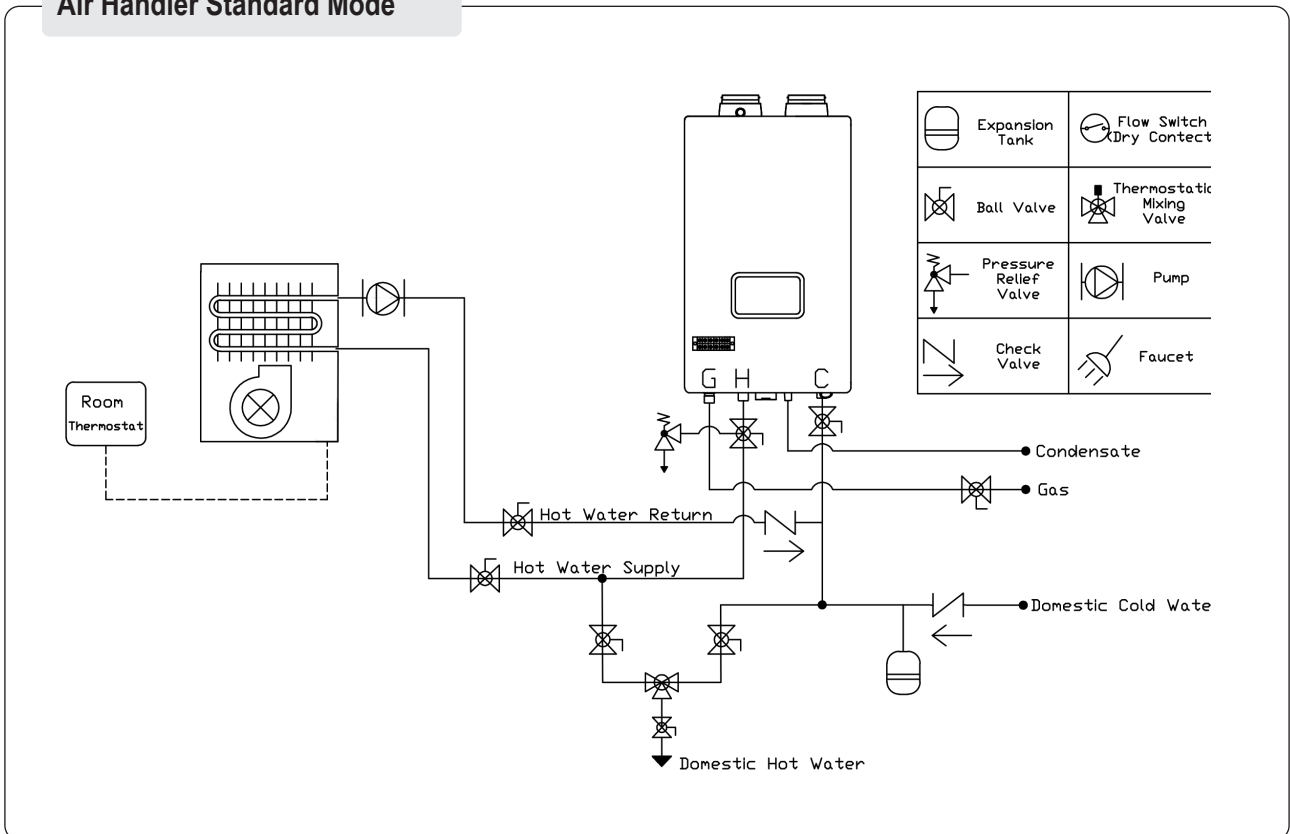


On Demand Mode

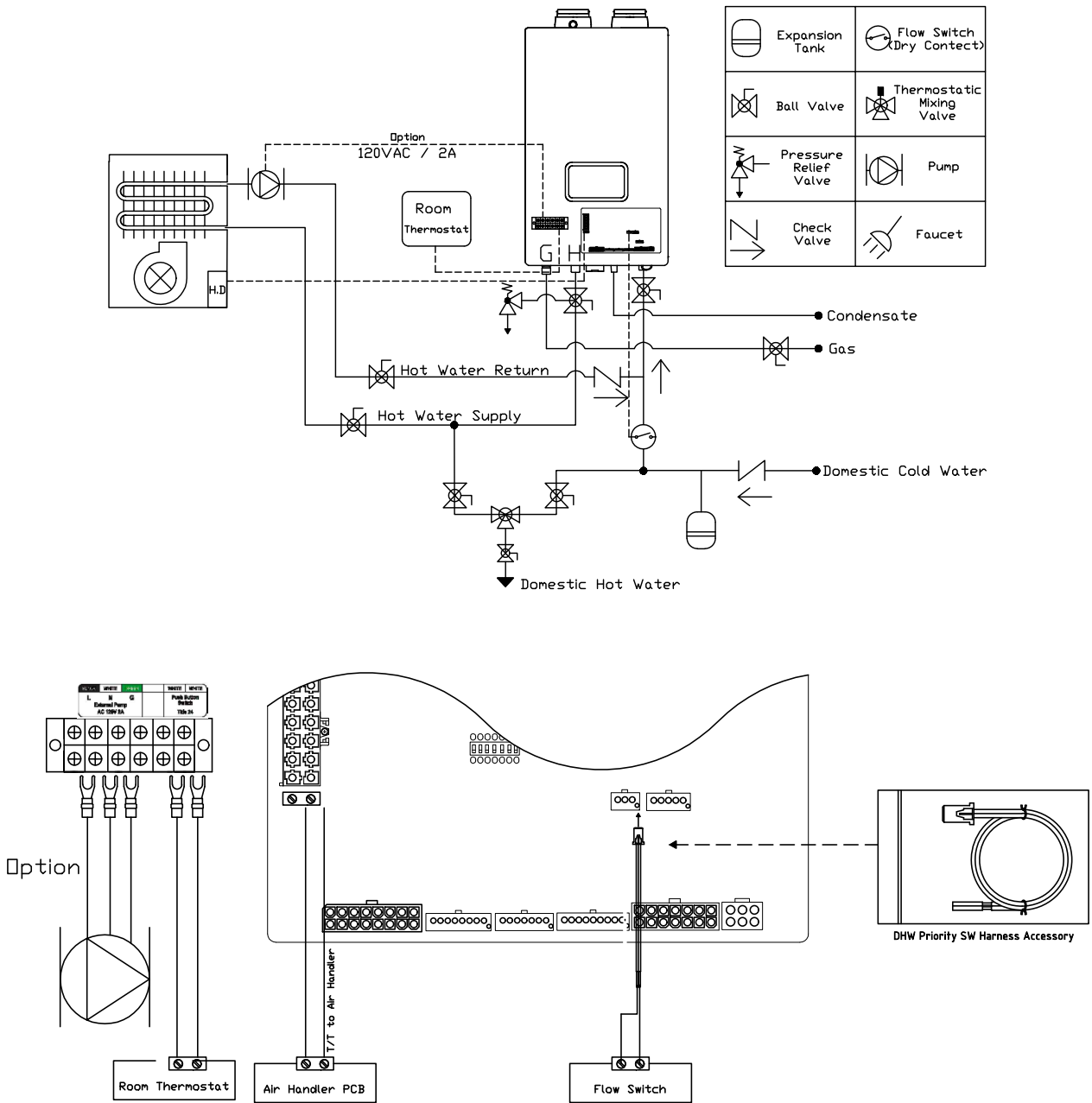


Mode	Description	Setting	Requirement		Performance
		12:Ah	Dedicated Return Line	Accessory	Energy Savings
Standard Air Handler	Pairs with Air handler for space heat.	Std	Yes	Thermostatic mixing valve	Good
Eco Air Handler	Incorporates DHW priority switch and anti-legionella function	ECO	Yes	Thermostatic mixing valve, DHW priority switch	Better

Air Handler Standard Mode



Air Handler Eco Mode



1. Water heater receives signal from the Room Thermostat and it will control the Air Handler as per flow switch condition
2. It prevents simultaneous operation of DHW and heating to eliminate cold wind during heating or lower water temperature during shower
3. No usage during Anti off setting time, it can operate arbitrarily during the Anti on time for preventing bacteria in the heating pipe.

SECTION 5 Multi-Unit Applications

5.1 Infiniti GR Modes and Piping Diagrams (RTGR199N1, RTGR199X1)

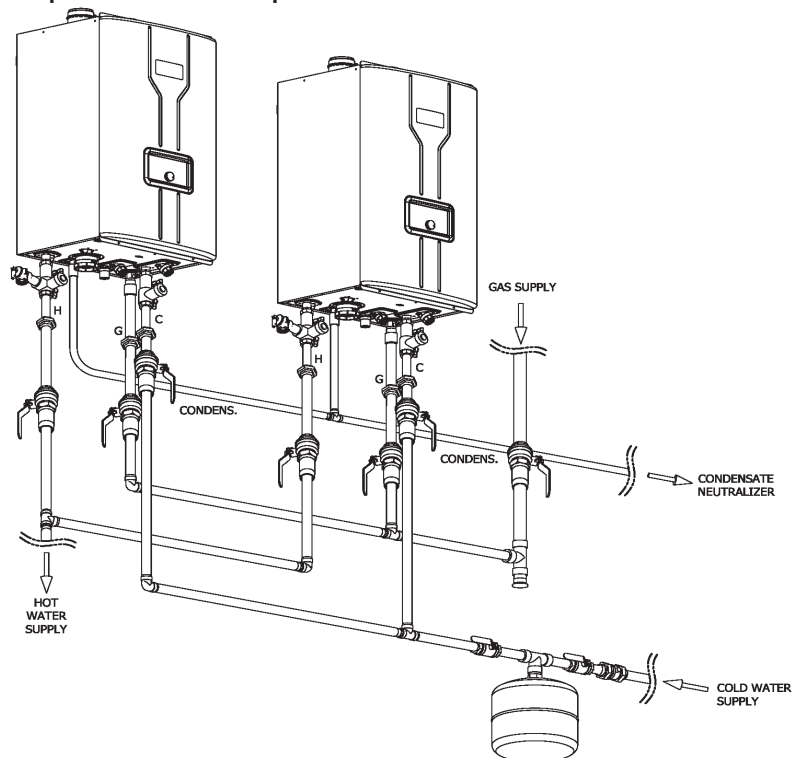
Mode	Description	Setting	Requirement		Performance		
		11:RC	Dedicated Return Line	Accessory	Wait Time Water Savings	Energy Savings	Hot Water Temperature
No Recirculation	Recirculation Pump remains Idle.	OFF	No	-	-	-	-
Internal	Hot water circulates within the appliance, No return line needed.	ltnl	No	-	Better	Better	Better
External	Hot water circulates using the return line.	Etnl	Yes	-	Best	Better	Best
Crossover	Hot water circulates within the house using 3rd party bypass valve.	CrOS	No	O	Best	Good	Warm

* Recirculation is activated by Timer [Auto / Manual].

Mode	Description	Setting	Requirement		Performance		
		13:Cn	Dedicated Return Line	Accessory	Wait Time Water Savings	Energy Savings	Hot Water Temperature
Cascaded	Multiple heaters used for increased heat capacity	01:Leader 02:Follower 1	No	Cascade Cable	-	-	-

No Recirculation Mode, Internal Recirculation Mode

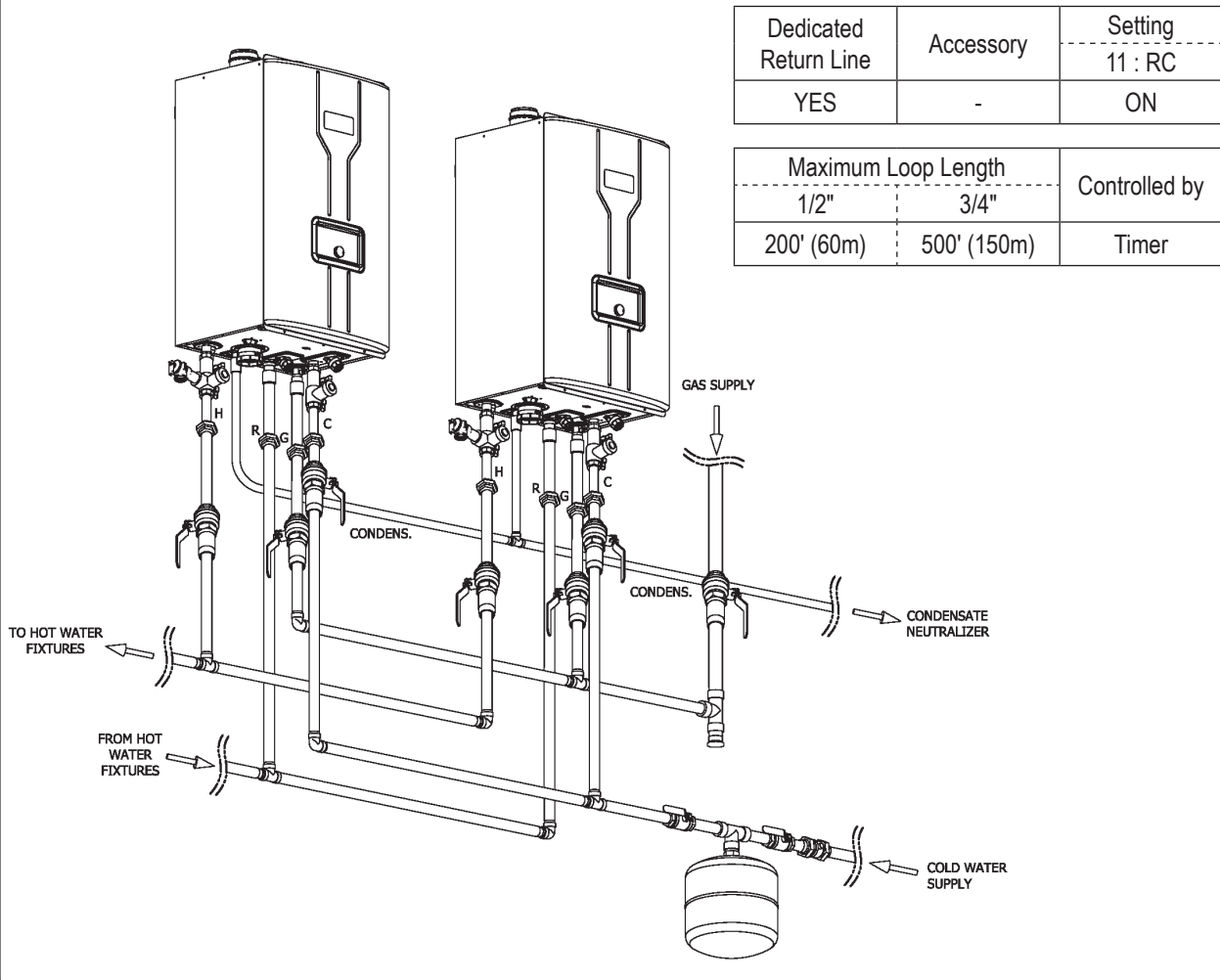
1. Only POTABLE water may be plumbed through the water heater.
2. The water heater cannot be used for space heating applications.
3. Expansion tank is required if a backflow preventer is installed.



Recirculation Mode

[External Mode]

- Provides most comfortable option. Maintains consistent hot water availability during specified times.
- Timer can be manually customized or programmed to automatically learn daily usage patterns.
- Ability to optimize by using Installer Mode function 3: RT to adjust loop temperature for maximum comfort and safety.



The recirculation pipe must be installed in the field in order to apply the 'External Mode'. This mode allows the water heater recirculation pipes to be warmed up and serving as the freeze protection function.

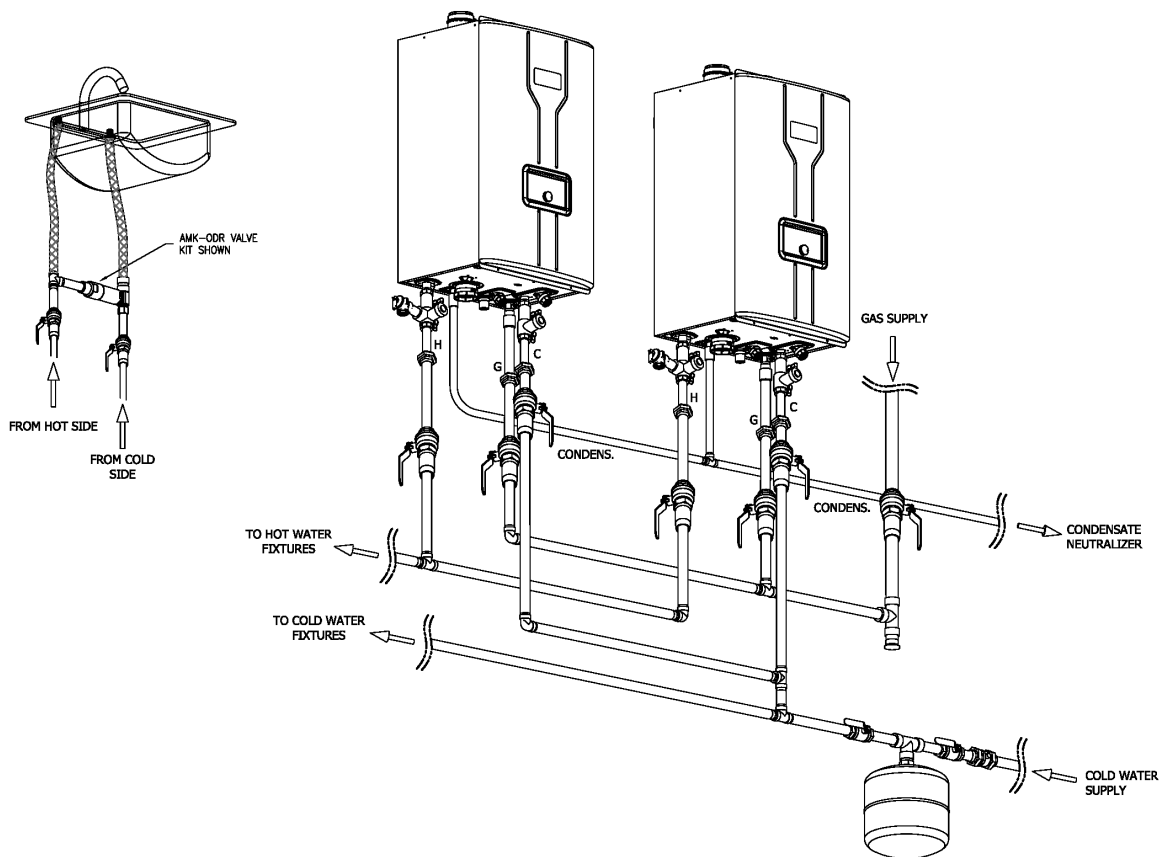
Recirculation Mode

[Crossover(CrOS) Mode]

- Provides recirculation option for homes without a dedicated return line by utilizing the cold water line as a return line.
- Timer can be manually customized or programmed to automatically learn daily usage patterns.
- In order to prevent hot water from being supplied into the cold water line, the thermal element in the crossover valve will close at 95°F. As a result, hot water may not be available at all times (only warm water).

Dedicated Return Line	Accessory	Setting
		11 : RC
NO	Crossover Valve	CrOS

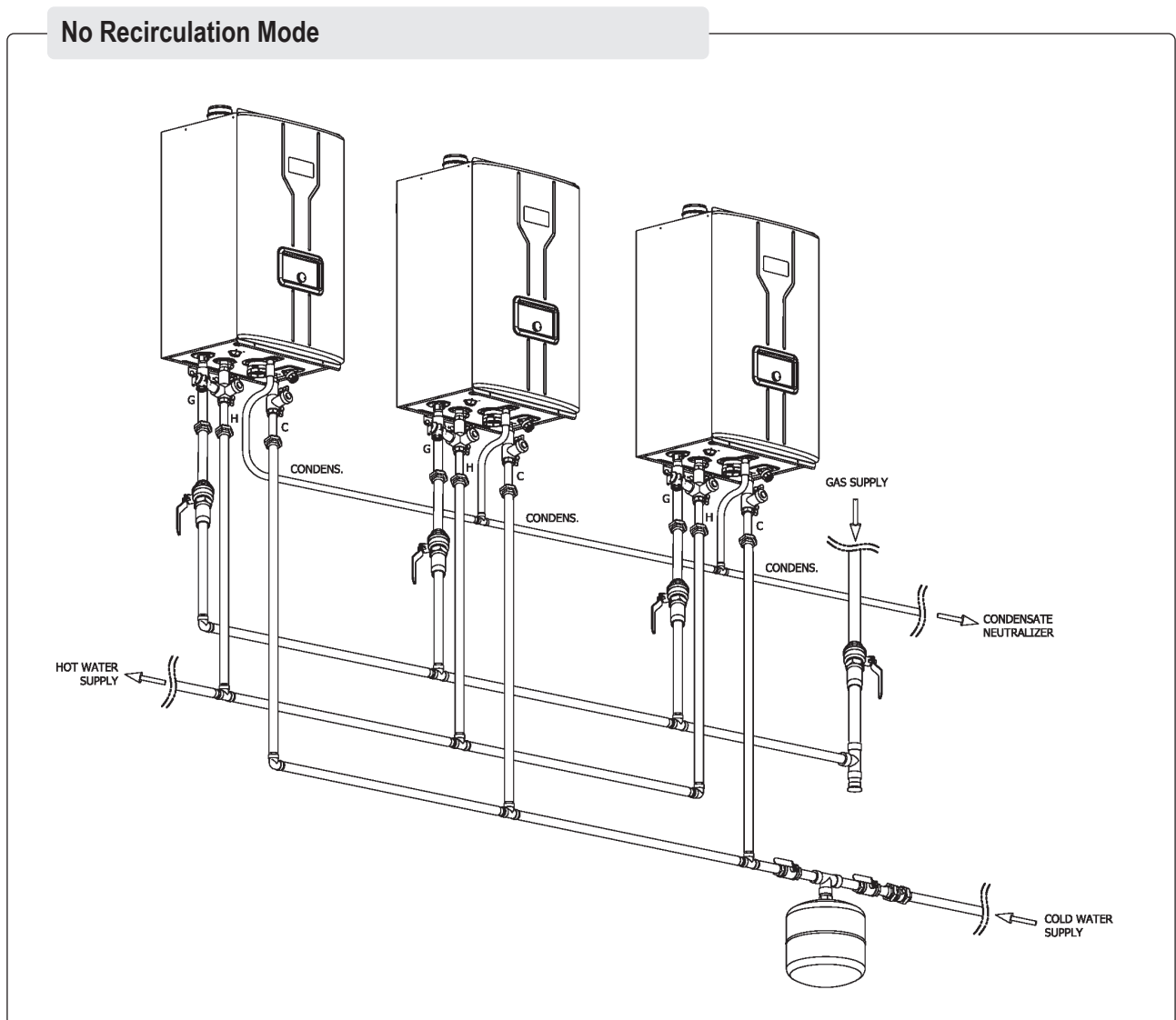
Maximum Loop Length		Controlled by
1/2"	3/4"	
200' (60m)	500' (150m)	Timer



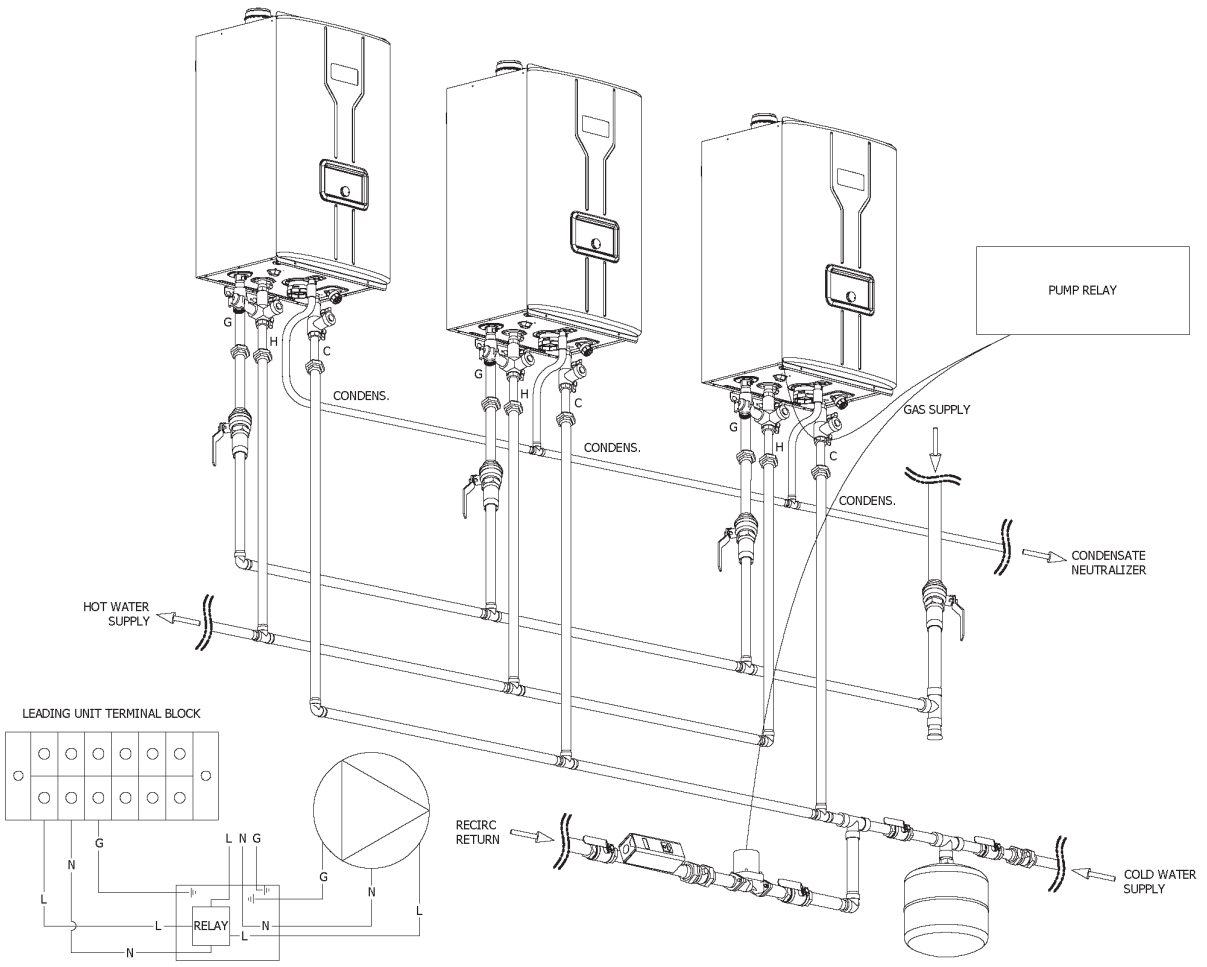
5.2 Infiniti GS Modes and Piping Diagrams (RTGS199N1, RTGS199X1)

Mode	Description	Setting	Requirement		Performance		
		11:RC	Dedicated Return Line	Accessory	Wait Time Water Savings	Energy Savings	Hot Water Temperature
No Recirculation	Recirculation Pump remains Idle.	OFF	No	-	-	-	-
Pulse	Unit controls an external pump with a dedicated return.	PuLS	No	-	Best	Better	Best

*Models not equipped with a built-in pump will require a field supplied circulator to be installed for use with recirculation modes. See sections 3.5 & 3.6

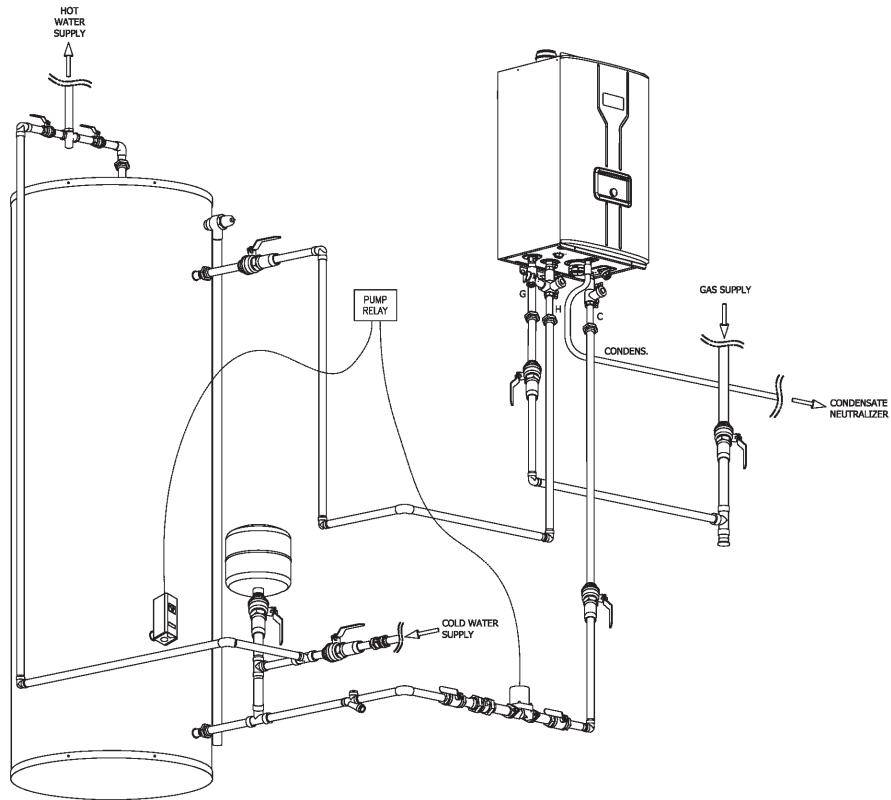


Pulse Mode

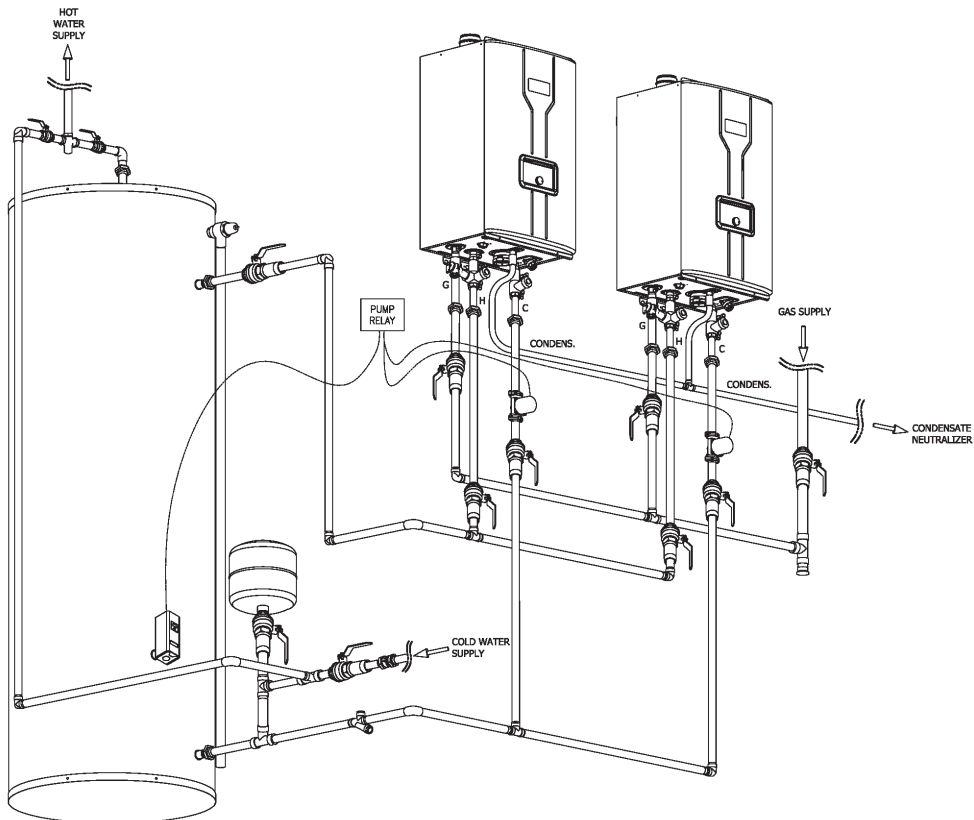


5.3 Tank Loading (RTGS199N1, RTGS199X1)

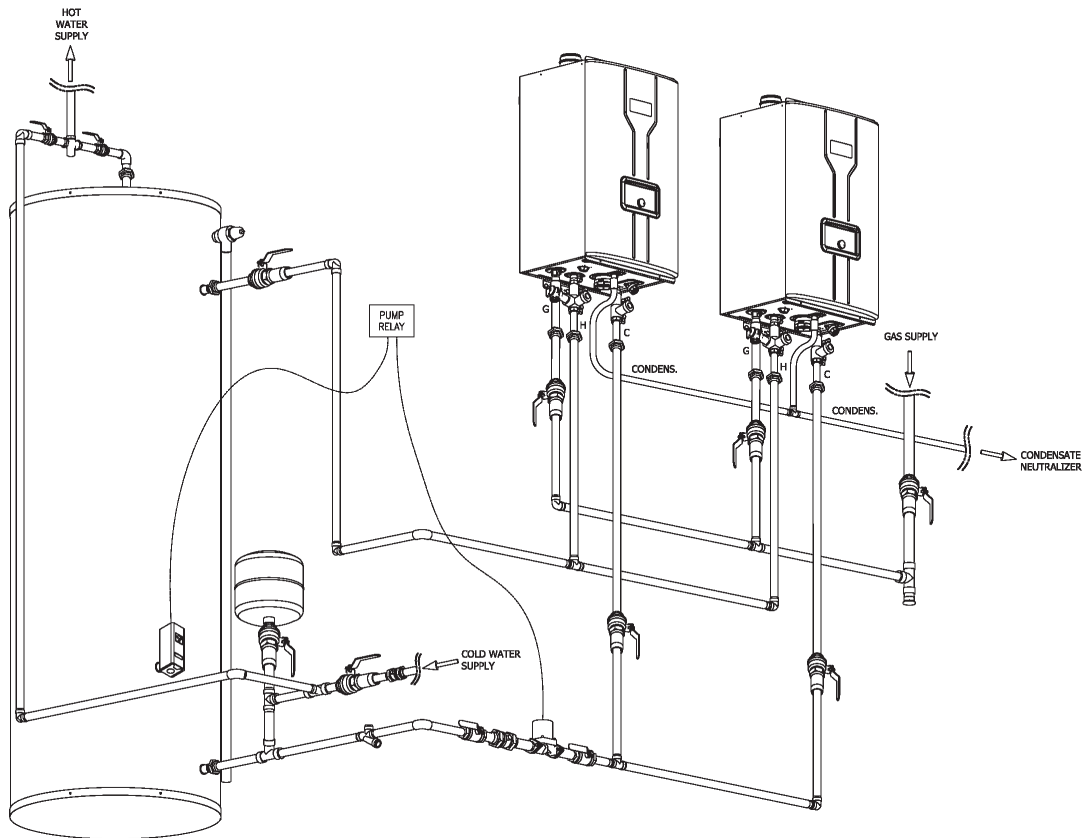
Single-unit RTGS with Tank Loading (One System Pump Shown)



Multi-unit RTGS with Tank Loading (Individual Pumps for each Unit Shown)

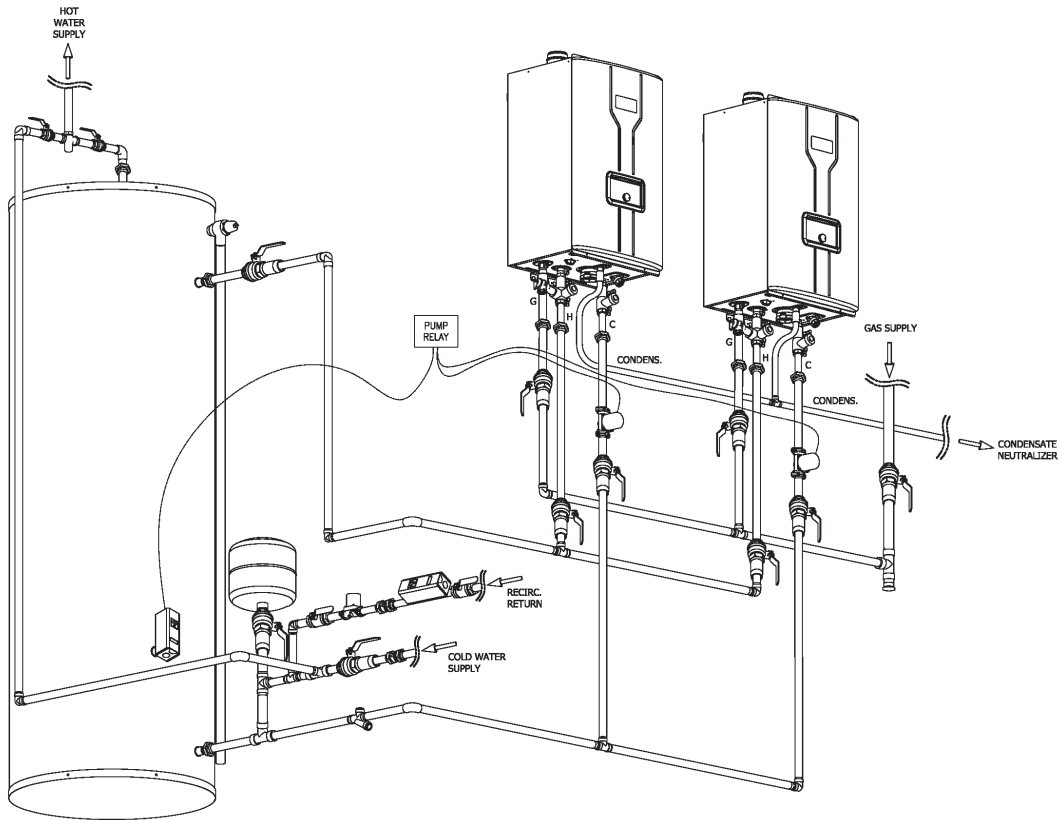


Multi-unit RTGS with Tank Loading (One System Pump Shown)

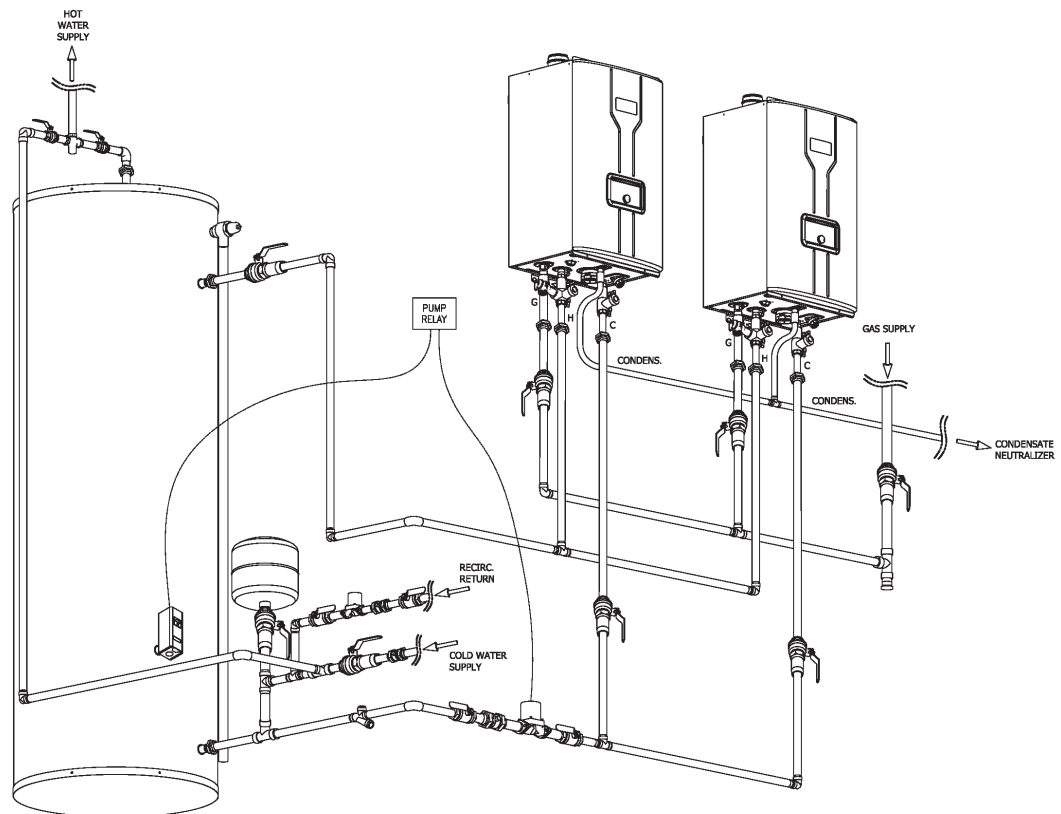


5.4 Tank Loading with Recirculation (RTGS199N1, RTGS199X1)

Multi-unit RTGS with Tank Loading and Recirculation (Individual Pumps for each Unit Shown)



Multi-unit RTGS with Tank Loading and Recirculation (One System Pump Shown)





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