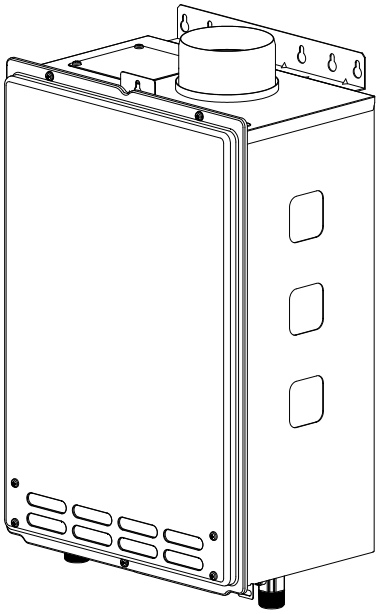
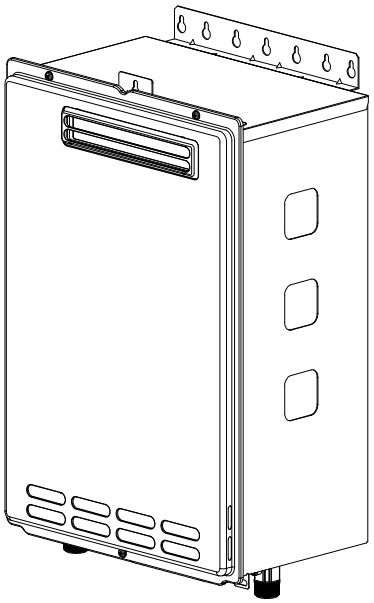
T-D2-IN / T-D2-OS

On-Demand Water Heater

Service Manual



T-D2-IN



T-D2-OS

A.O. Smith Water Products Company
500 Tennessee Waltz Parkway
Ashland City, TN 37015
Toll Free: 1-877-737-2840

Table of Contents

1. Specifications

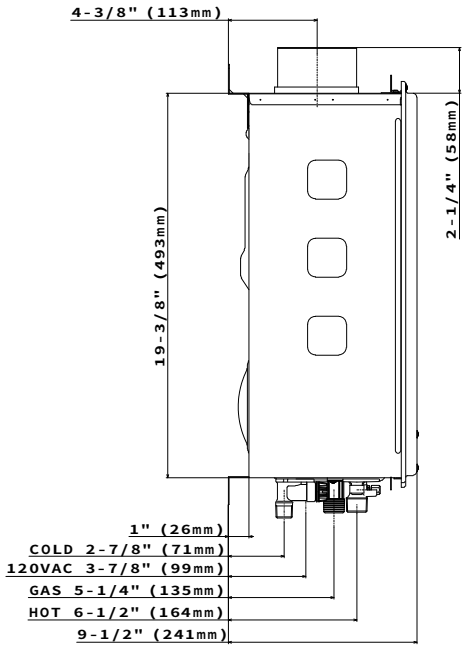
Model			T-D2-IN	T-D2-OS
Dimensions			H20.5"×W13.8"×D8.5"	
Weight			39 lbs.	
Combustion	INPUT BTU/h	Max	199,000	
		Min	11,000	
	Combustion System		Power vent	
	Installation		Indoor & Direct-vent	Outdoor
	Fan motor		PWM turbo fan	PWN multi blade fan motor
	Manifold Pressure*	Max	LP 3.5" WC Natural 2.0" WC	LP 4.4" WC Natural 2.8" WC
		Min	LP 0.7" WC Natural 0.4" WC	LP 0.9" WC Natural 0.5" WC
Water control	Flow rate		0.75 to 10.0 GPM	
	Available set temperatures		99 to 185°F default: 122°F	
	Temperature dipswitch settings		104°F, 113°F, 122°F, 131°F, 140°F, 158°F, 176°F, 185°F	
	Bypass valve		Yes	
	Thermistors		3 thermistors (In, Out, Mixing)	
Operation	Remote controller model		TM-RE30	
	PCB model		T-D2	
	Indicators		Red LED on PCB during operation & 7-SEG LED	
	Power supply control		Surge absorber & Power ON-OFF switch	
Features	Freeze protection		Ceramic heaters and Auto-firing system	
	Self-combustion improvement		Air-Fuel Ratio Detection System	
	Easy-Link system		Yes (Up to 4 units)	
	Multiple-system		N/A	

*The manifold pressure measurement is based on conditions without front cover.

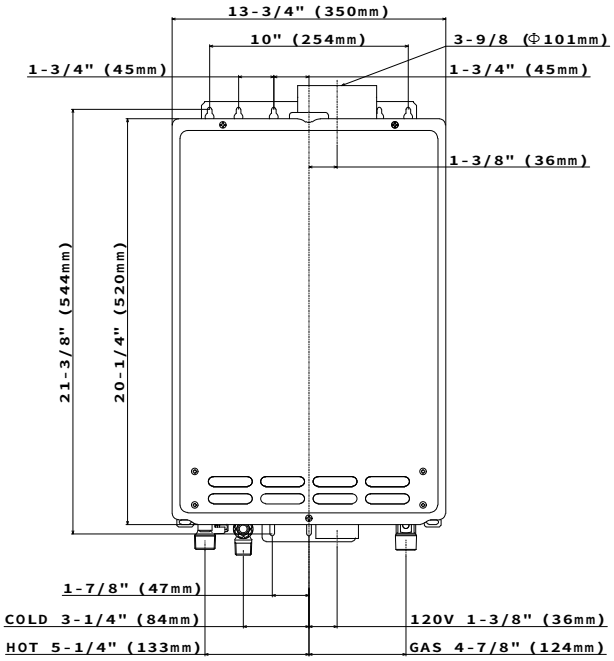
2. Exterior view

T-D2-IN

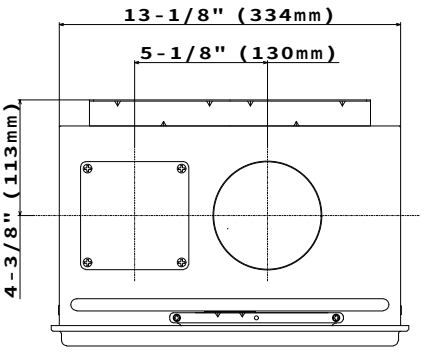
Side view



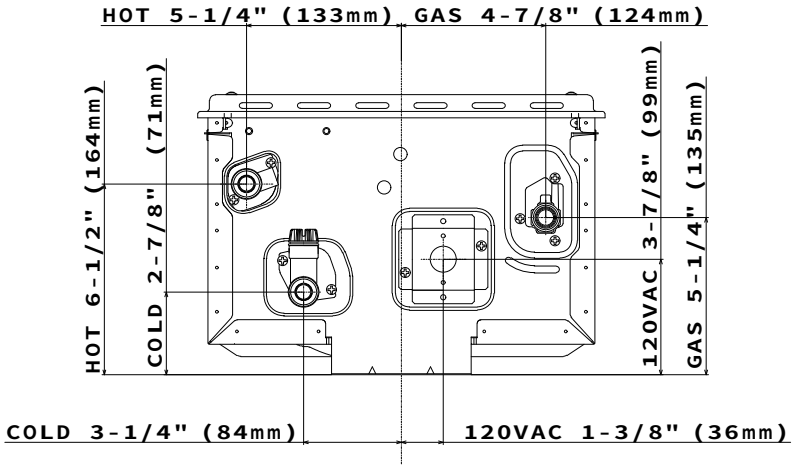
Front view



Top view

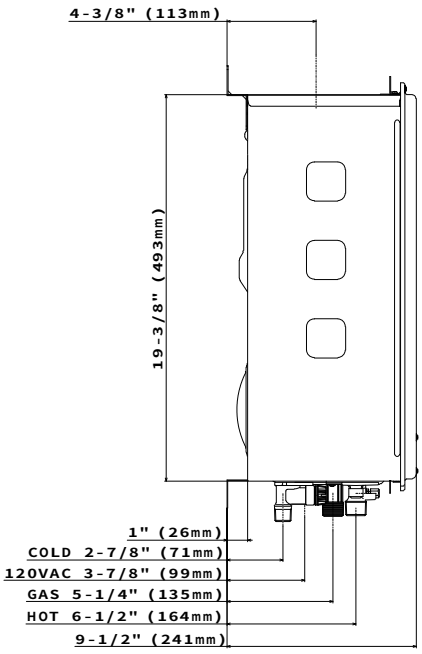


Bottom view

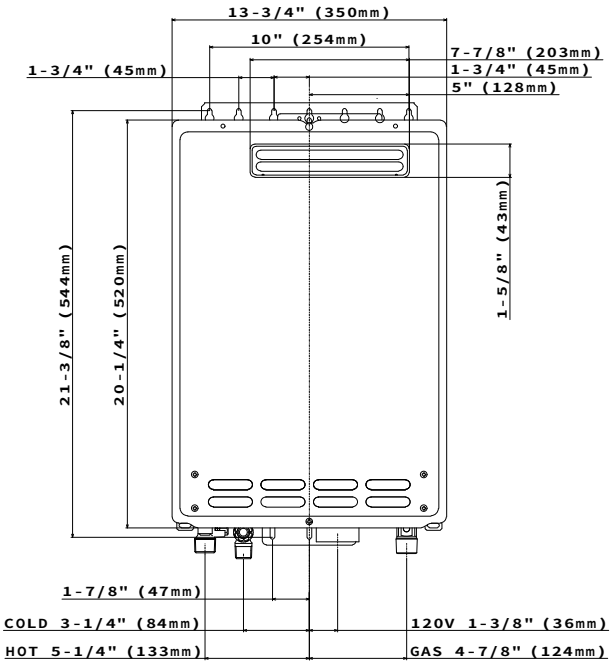


T-D2-OS

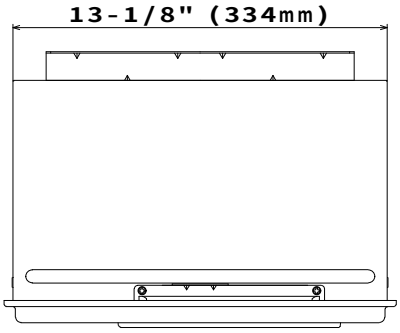
Side view



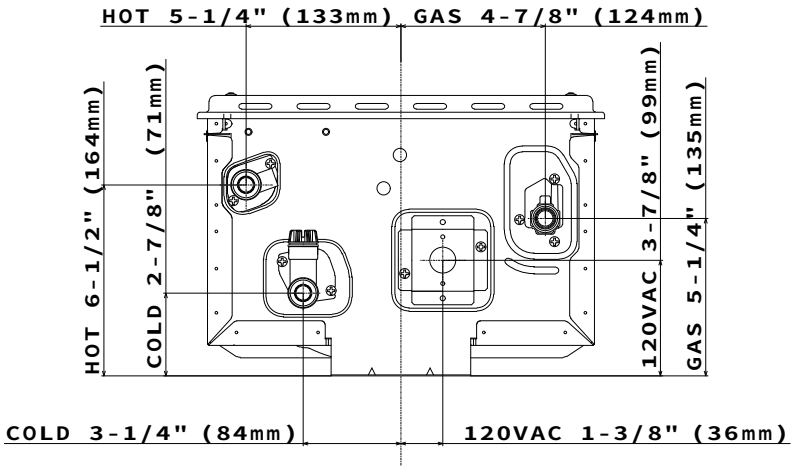
Front view



Top view

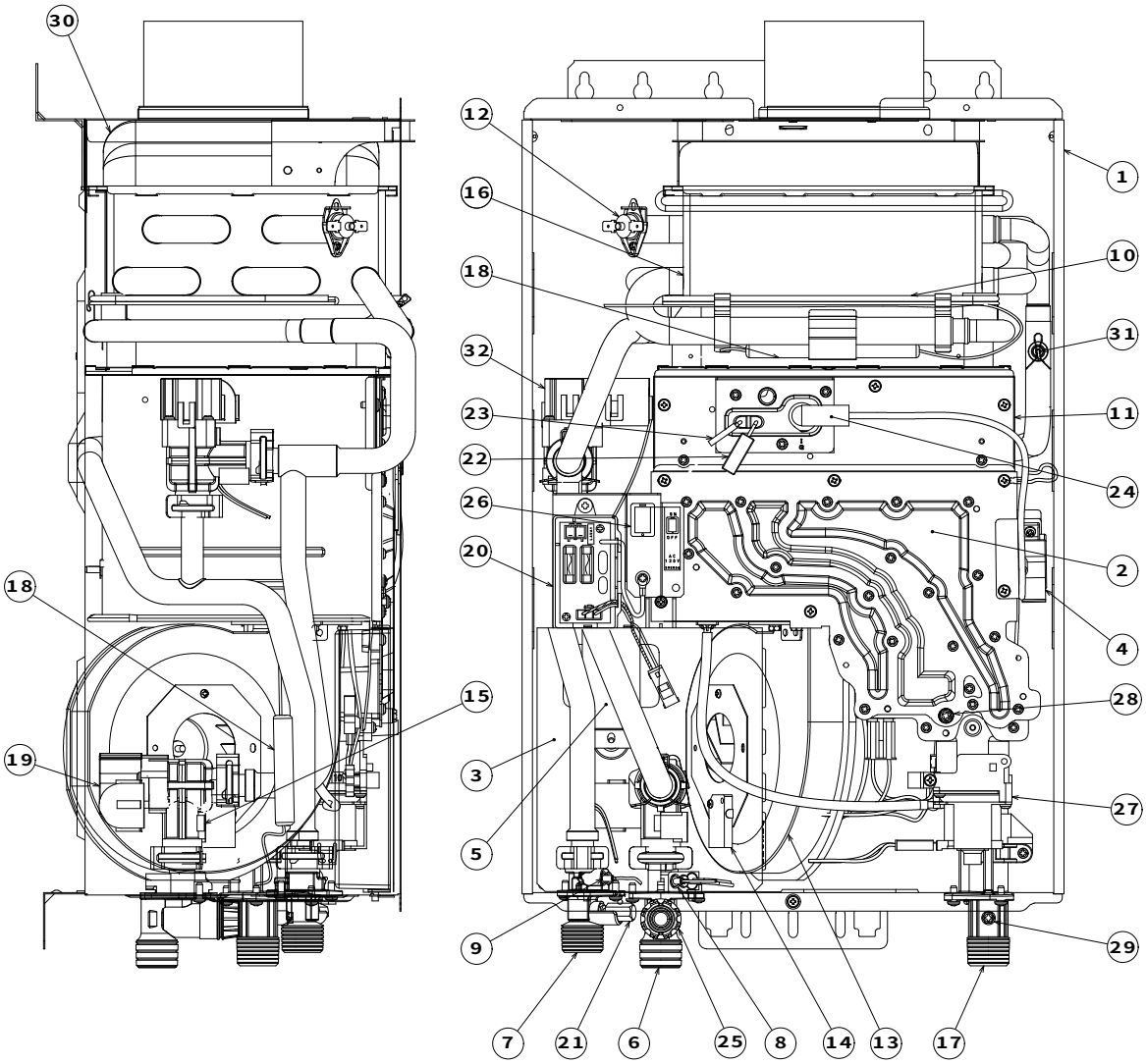


Bottom view

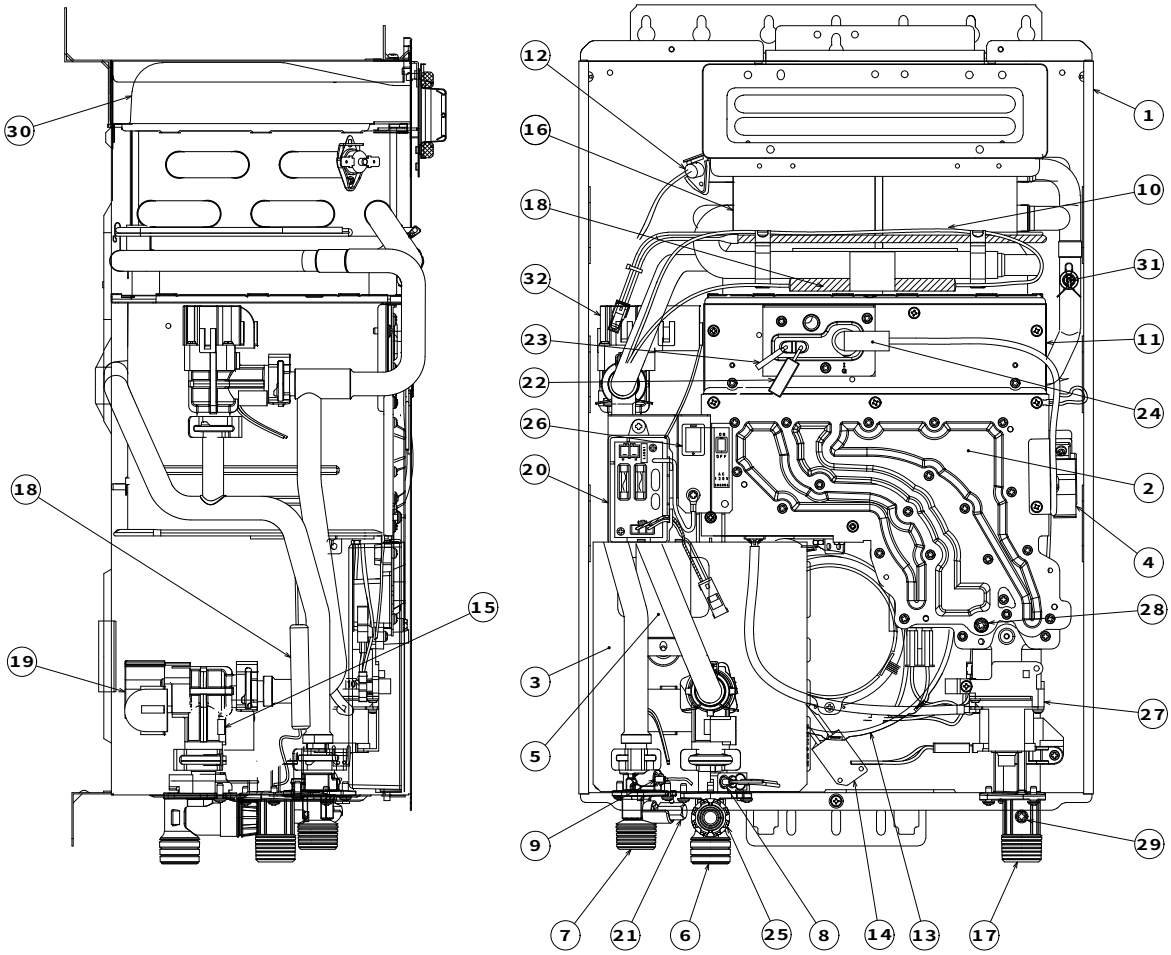


3. Interior view

T-D2-IN



T-D2-OS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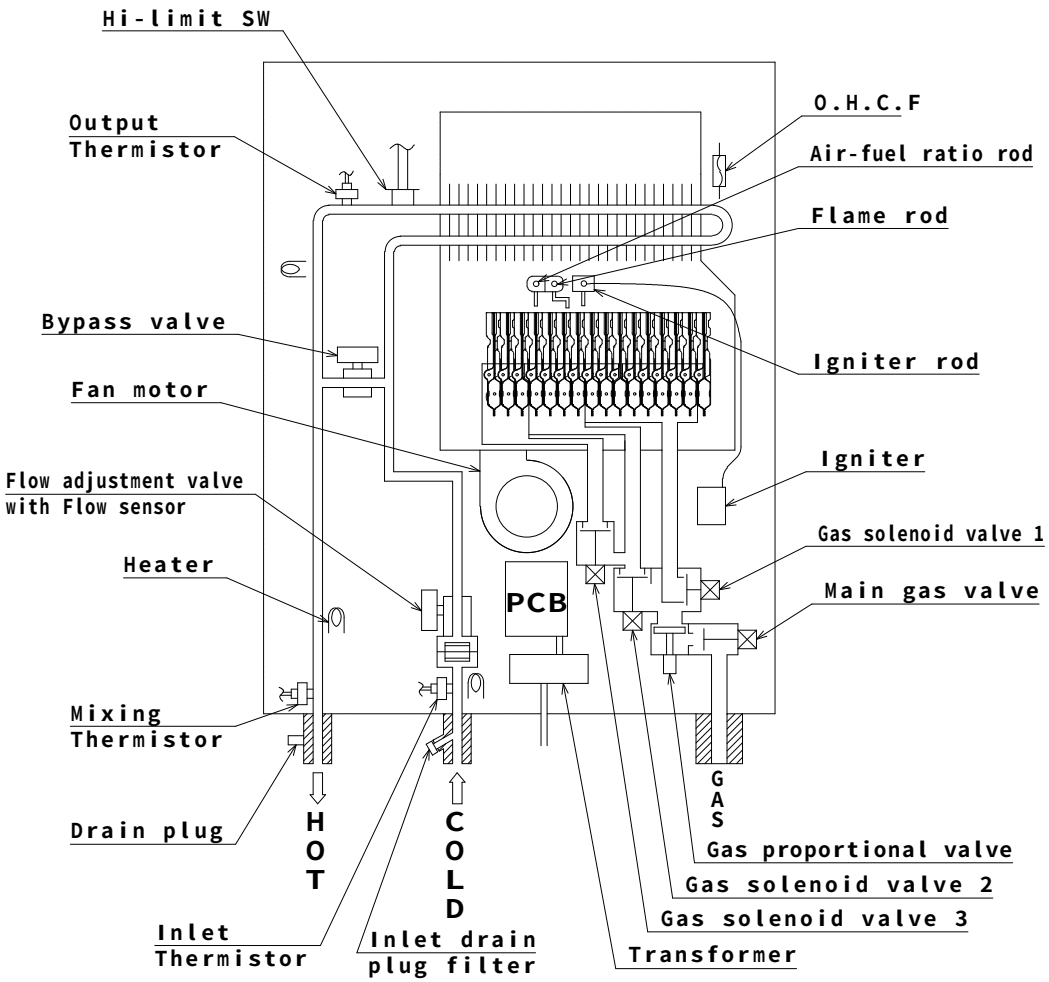
4. List of main components in the interior view

No.	Description	Items# in components diagram	Takagi Part #	Common parts for other models
1	**Case assembly**	**001**	**EK402 (T-D2-IN)**	
			EKK41 (T-D2-OS)	**T-K3OS**
2	**Manifold assembly with gas valve assembly**	**102**	**EKH6T (LP model)**	**T-H2-DV/OS**
			EKK5K (NA model)	
3	Computer board	701	EK439	
4	Igniter	711	EKN74	T-K3, T-K3-Pro, T-K3-SP/OS, T-H2-DV/OS , T-KJr2-IN/OS, T-K4-IN/OS, T-M50, T-M32
5	Transformer	702	EKH09	T-K3, T-K3-Pro, T-K3-SP/OS,
6	Water inlet	404	EKK1U	T-K3, T-K3-Pro, T-K3-SP/OS, T-KJr2-IN/OS, T-K4-IN/OS
7	Water outlet	409	EKK1V	T-K3, T-K3-Pro, T-K3-SP/OS, T-KJr2-IN/OS, T-K4-IN/OS
8	Inlet thermistor	407	EKK38	T-K3, T-K3-Pro, T-H2-DV/OS , T-M50, T-M32
9	Mixing thermistor	408	EKK1A	T-K3, Pro, T-M50
10	Overheat cut-off fuse	413	EK333	T-K3, T-K3-Pro, T-K3-SP/OS, T-KJr2-IN/OS, T-K4-IN/OS, T-M50
11	Burner assembly (Burners)	101	EKH5W	T-H2-DV/OS
12	Hi-limit switch	412	EKN34	T-K3, T-K3-Pro, T-K3-SP/OS, T-H2-DV/OS , T-M50, T-M32
13	**Fan motor**	**103**	**EKK25 (T-D2-IN)**	**T-K3, T-K3-Pro, T-K3-SP, T-H2-DV/OS , T-M50, T-M32**
			EKK54 (T-D2-OS)	**T-K3-OS, T-K4-OS**
14	**Freeze protection thermostat**	**713**	**EKJ59 (T-D2-IN)**	**T-K3, T-K3-Pro, T-K3-SP, T-M32**
		710	**EKK40 (T-D2-OS)**	**T-K3-OS, T-KJr2-OS, T-K4-OS**

No.	Description	Items# in components diagram	Takagi Part #	Common parts for other models
15	Flow sensor	402	EK438	
16	**Heat exchanger assembly**	**401**	**TU002 (T-D2-IN)**	
			EK437 (T-D2-OS)	
17	Gas inlet	118	EKK1E	T-K3, T-K3-Pro, T-K3-SP/OS, T-KJr2-IN/OS, T-K4-IN/OS, T-H2-DV/OS
18	Heater	414	EKK2R	T-K3, T-K3-Pro, T-K3-SP/OS, T-KJr2-IN/OS, T-K4-IN/OS
19	Flow adjustment valve	402	EK438	
20	Surge box	703	EK428	T-KJr2-IN/OS, T-K4-IN/OS
21	Outlet drain plug	410	EKK2E	T-K3, T-K3-Pro, T-K3-SP/OS, T-KJr2-IN/OS, T-K4-IN/OS, T-M50
22	Air-fuel ratio rod (AFR rod)	108	EKK0E	T-K3, T-K3-Pro, T-K3-SP/OS, T-H2-DV/OS, T-M50, T-M32
23	Flame rod	108	EKK0E	T-K3, T-K3-Pro, T-K3-SP/OS, T-H2-DV/OS, T-M50, T-M32
24	Igniter rod	109	EKK0F	T-K3, T-K3-Pro, T-K3-SP/OS, T-H2-DV/OS, T-M50, T-M32
25	Inlet drain plug (water filter)	405	EKK2B	T-K3, T-K3-Pro, T-K3-SP/OS, T-KJr2-IN/OS, T-K4-IN/OS
26	120 VAC Power ON-OFF switch	706	EKK4V	T-K3-SP/OS, T-KJr2-IN/OS, T-K4-IN/OS, T-H2-DV/OS
27	**Gas valve assembly**	**Included in #102**	**EKH6T (LP model)**	**T-H2-DV/OS**
			EKK5K (NA model)	
28	Manifold port	N/A	N/A	
29	Gas inlet port	N/A	N/A	
30	**Exhaust chamber**	**Included in #401**	**TU002 (T-D2-IN)**	**T-H2-DV/OS**
			EK437 (T-D2-OS)	
31	Output thermistor	411	EKK2T	
32	Bypass valve	403	EKK0U	

5. Schematic diagram

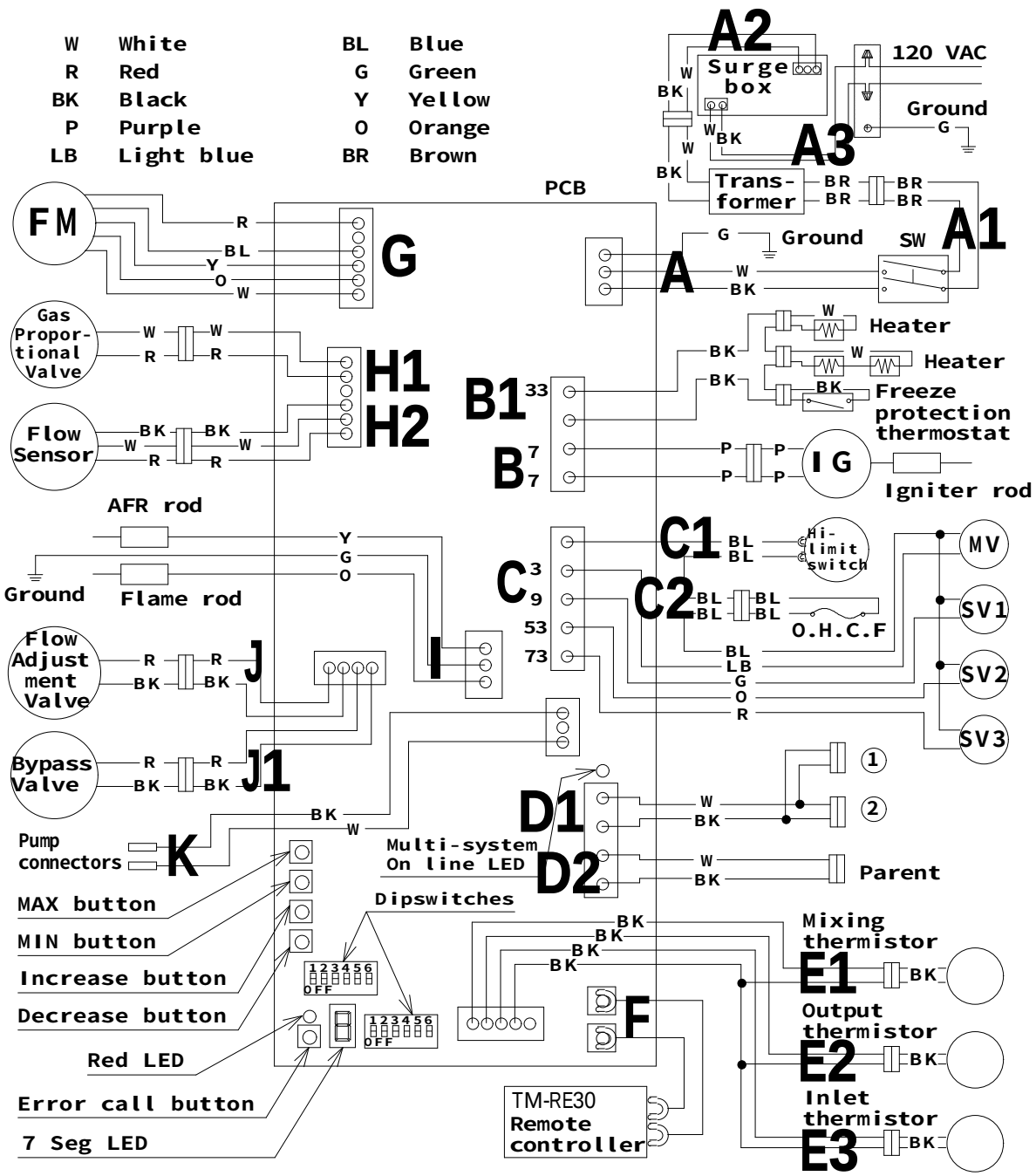
The diagram below refers to both the T-D2-IN and T-D2-OS.



1. When a hot water tap is opened, cold water enters the T-D2-IN or T-D2-OS.
2. The water flow sensor detects this water flow and sends this information to computer.
3. The computer initiates fan motor and sends signal to igniter to create ignition spark.
4. The main, proportional, and solenoid gas valves open to allow gas input.
5. The gas ignites and flames appear inside the burner chamber.
6. Water circulates through the heat exchanger and is heated up to the set temperature.
7. Using thermistors to measure temperatures, the computer modulates the gas and water valves to ensure proper output water temperatures.
8. When the tap is closed, the T-D2-IN or T-D2-OS shuts down.

6. Wiring diagram

The diagram below refers to both the T-D2-IN and T-D2-OS.



7. Wiring diagram check points for diagnosis

The table below applies to both the T-D2-IN and T-D2-OS.

Check-point	Part and Description	Color of wires	Normal range
A, A1	100V Power supply	White – Black (A) Brown – Brown (A1)	90 to 110 VAC
A2, A3	120V Power supply	Black - White	108 to 132 VAC
B	Igniter	Purple - Purple	90 to 110 VAC
B1	Heater	Black - Black	90 to 110 VAC
C	Gas valves	Light blue - blue at COM (MV)	78 to 100 VDC (during operation) / 0.9 to 1.3 kΩ
		Green - blue at COM (SV1)	78 to 100 VDC (during operation) / 1.3 to 1.9 kΩ
		Orange - blue at COM (SV2)	78 to 100 VDC (during operation) / 1.3 to 1.9 kΩ
		Red - blue at COM (SV3)	78 to 100 VDC (during operation) / 0.9 to 1.7 kΩ
C1	Hi-limit switch	Blue - Blue	Less than 1 VDC and less than 1.0 Ω
C2	Overheat cutoff fuse	Blue - Blue	Less than 1 VDC and less than 1.0 Ω
D1,D2	Easy-link connectors	Black - White	15 VDC (during Easy-link operation)
E1	Mixing thermistor	Black - Black	See table on p. 11
E2	Output thermistor	Black - Black	
E3	Inlet thermistor	Black - Black	
F	Remote controller	*	11 to 25 VDC
G	Fan motor	Red - Blue	110 to 160 VDC
		Yellow - Blue	13 to 17 VDC
		Orange - Blue	2 to 6.5 VDC

Check-point	Part and Description	Color of wires	Normal range
H1	Gas proportional valve	White - red	1 to 15 VDC (during operation) and 20 to 40 Ω
H2	Flow sensor	Red - Black	4 to 5.5 VDC
		White - Black	1 to 4 VDC (pulse) 1,080 pulse / min (more than 18 Hz)
I	Air-fuel ratio rod	Yellow - AFR rod (Between AFR rod and the computer board)	More than 0.5 μA (during operation)
	Flame rod	Orange - Flame rod (Between flame rod and the computer board)	More than 1 μA (during operation)
J	Flow adjustment valve	Red - Black	7 to 16 VDC and 0.09 to 0.2 kΩ
J1	Bypass valve	Red - Black	7 to 16 VDC and 0.09 to 0.2 kΩ
K	Pump connector port	White - Black	Less than 1.3 Ω

8. Resistance values of the temperature thermistors

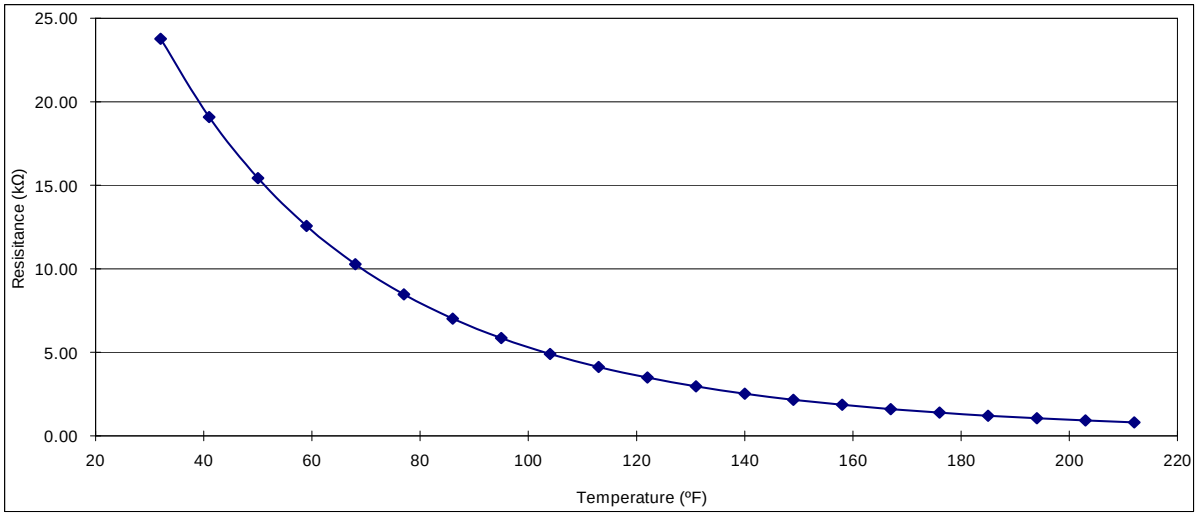
The T-D2-IN and T-D2-OS use the same thermistors.

Resistance values at different temperatures

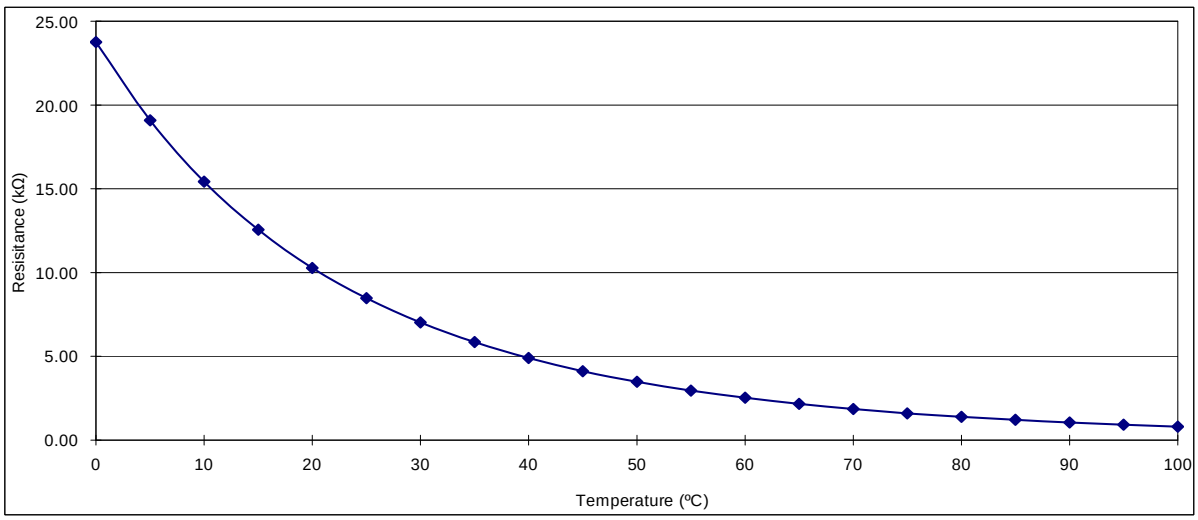
Temperature	ºF	32	41	50	59	68	77	86	95	104	113	
	ºC	0	5	10	15	20	25	30	35	40	45	
Resistance	kΩ	23.76	19.08	15.43	12.56	10.28	8.47	7.02	5.85	4.90	4.12	

Temperature	ºF	122	131	140	149	158	167	176	185	194	203	212
	ºC	50	55	60	65	70	75	80	85	90	95	100
Resistance	kΩ	3.49	2.96	2.53	2.16	1.86	1.60	1.39	1.21	1.05	0.92	0.81

Temperature(ºF) vs. Resistance(kΩ)

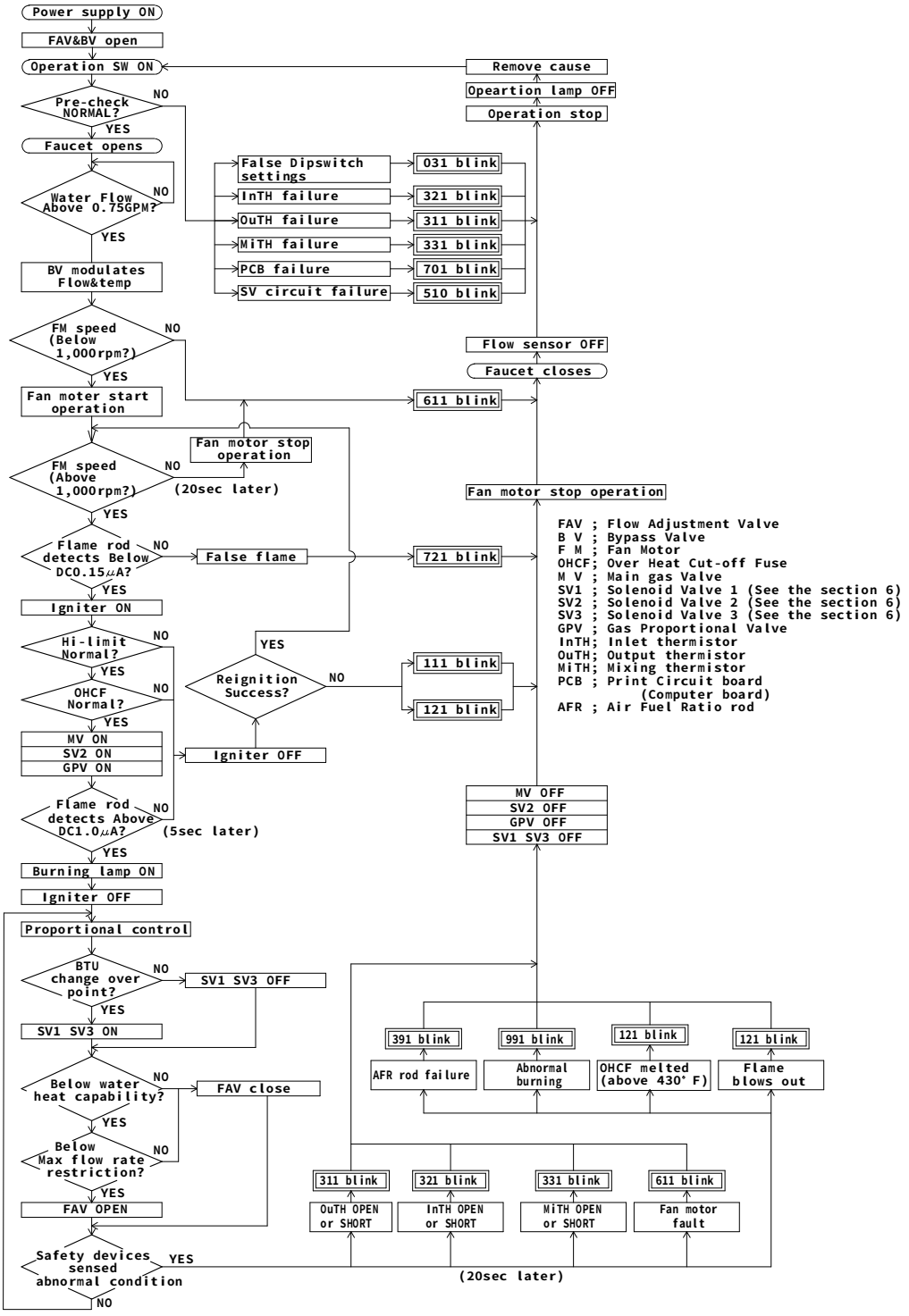


Temperature(℃) vs. Resistance(kΩ)



9. Operational flow chart

The diagram below refers to both the T-D2-IN and T-D2-OS.



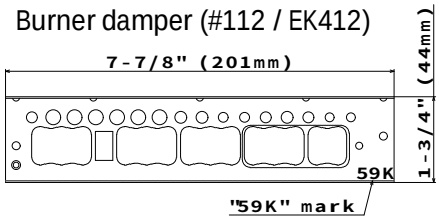
10. Component specifications

10-1. Burners

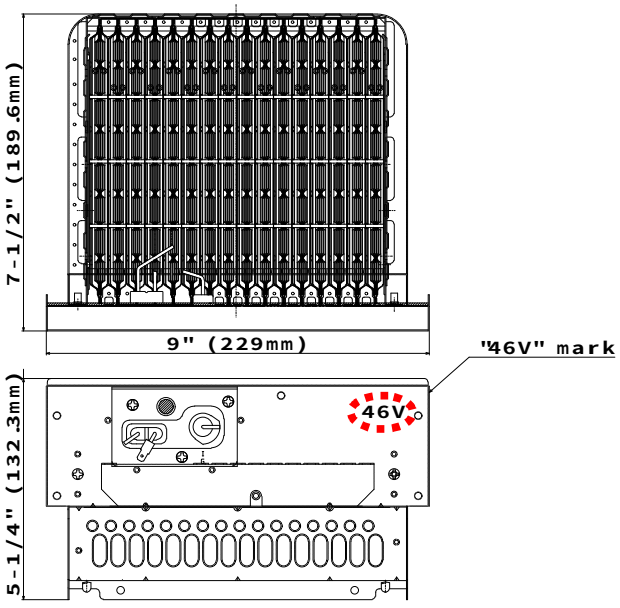
Unit Part #	#101	**Takagi Part** #	EKH5W	**Checkpoint**	**N/A**
Function	There are 2 types of burners in the water heater: the gas-rich burner stabilizes the flames within the combustion chamber and the air-rich burner produces more heat in the combustion chamber. The burners facilitate the air/gas mixture necessary to produce the proper heat during the combustion reaction.				
Failure events	1. Unable to initialize/sustain combustion. 2. Dust or soot deposit on the burner surface. 3. Cracks on the burners. 4. Gas leakage from the burners.				
Effects on the water heater if burners fails	1. Unexpected combustion. 2. Unstable flame conditions and/or flame loss. 3. Ignition failure. 4. Back-firing.				
Error codes when the burners fails	**101**	**111**	**121**	**991**	
Diagnostic	Visual inspection: excessive dust deposit on the burner surface and/or unstable flame conditions during operation.				
Color/Number of wires	**N/A**				

The burner for the T-D2-IN and T-D2-OS has the “46V” mark as shown below.

Burner damper (#112 / EK412)

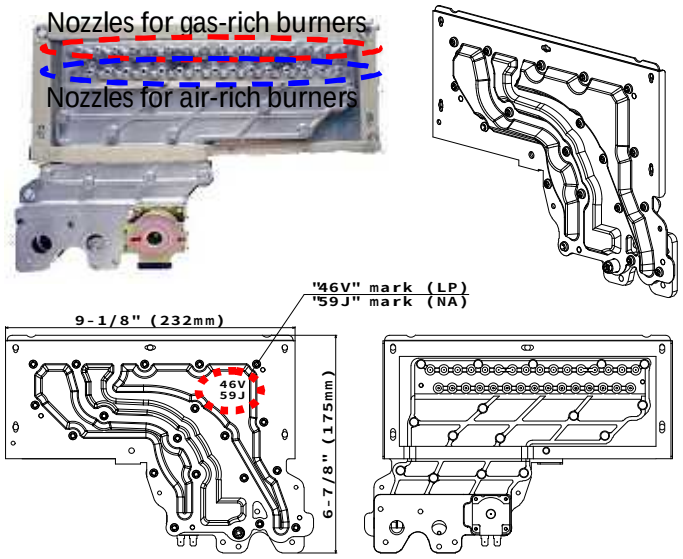


The burner damper is not included in EKH5W.



10-2. Gas manifold

Unit Part #	Included in #102	**Takagi Part** #	EKH6T (LP model) EKK5K (NA model)	**Checkpoint**	**N/A**
Function	1. The manifold distributes gas from the gas valves to the burners. The manifold has two types of the nozzles: one type for gas-rich burners (16 nozzles) and the other for air-rich burners (15 nozzles) 2. There are 3 zones within the manifold, to ensure efficient combustion operation.				
Failure events	1. Dust deposit on the manifold. 2. Gas leakage from a failed manifold. 3. Ignition failure. 4. Imperfect combustion.				
Effects on the water heater if the manifold fails	1. The burners cannot receive proper gas flow from the manifold, which can cause poor combustion in the combustion chamber. In this case, the AFR rod will detect an improper flame condition and computer will take safety measures. 2. Gas leakage from the manifold.				
Error codes when the manifold fails	**101**	**111**	**121**	**991**	
Diagnostic	1. Visual inspection: Excessive dust deposit around the nozzles or cracks on the manifold. 2. Check voltages and resistance: proper range of values shown below.				
Color/Number of wires	Blue-Red		78 to 100 VDC / 0.9 to 1.7 kΩ		



EKH6T (for LP model) and EKK5K (for NA model) is an assembly of the gas manifold with the gas valve assembly. For safety reasons, these assemblies should be installed in the unit as a whole set.

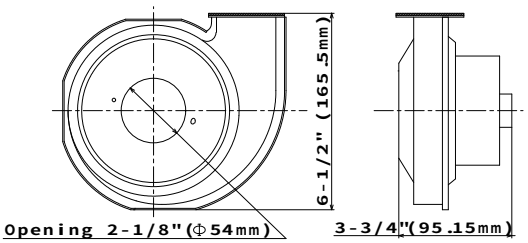
The gas manifold for the LP has the “46V” mark, and the gas manifold for the NA has the “59J” mark on the manifold plate.

10-3. Fan motor

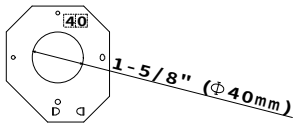
Unit Part #	#103	**Takagi Part** #	EKK25 (T-D2-IN) EKK54 (T-D2-OS)	**Checkpoint**	**G**
Function	To provide combustion air into the combustion chamber and to exhaust flue gas.				
Failure events	1. Fan speed failure, causing abnormal sounds with or without combustion during operation. 2. Unexpected activation caused by the connectors of the fan motor getting wet. 3. Disconnects from the bottom of the combustion chamber.				
Effects on the water heater if fan motor fails	1. The water heater does not function properly. 2. Failure to ignite or abnormal ignition. 3. Unstable combustion conditions.				
Error codes when the fan motor fails	**101**	**111**	**121**	**611**	**991**
Diagnostic	1. Visual inspection: connection/breakage of wires or dust (causing electrical shortage) 2. Voltage check: proper range of voltages shown below.				
Color/Number of wires	Red-Blue	110 to 160 VDC (Input)			
	Yellow-Blue	13 to 17 VDC (Input)			
	Orange-Blue	2.0 to 6.5 VDC (Input)			
	White-Blue	Verify the fan motor speed using the Diagnostics Mode of the TM-RE30 temperature remote controller. See Section 12-1 for details.			

T-D2-IN

PWN turbo fan motor



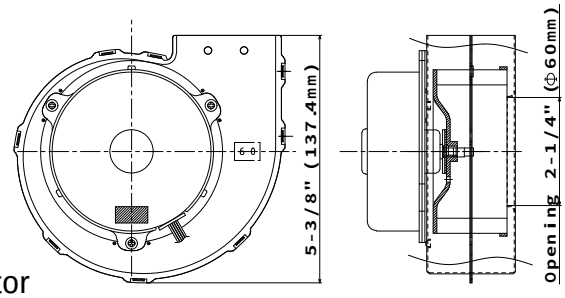
Fan damper (#115 / TU001)



The fan damper is not included in EKK25.

T-D2-OS

PWN multi blade fan motor

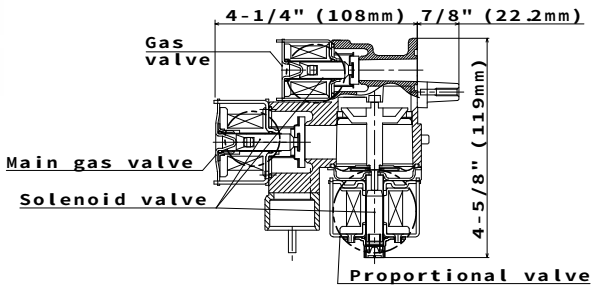


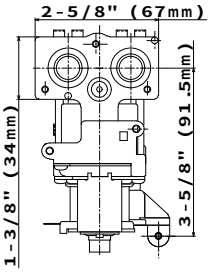
10-4. Gas valve assembly

Unit Part #	Included in #102	**Takagi Part #**	EKH6T (LP model) EKK5K (NA model)	**Checkpoint**	**C,H1**
Function	Opens and closes the gas pathways of the water heater (main and solenoid gas valves)				
	Modulates the gas flow from the gas inlet (proportional gas valve)				
Failure events	1. Gas leak from the valves. 2. Unable to open/close (main and solenoid gas valves) 3. Unable to modulate the gas flow (proportional gas valve)				
Effects on the water heater if valves fails	1. Gas leak from the unit. 2. Excess carbon monoxide emissions. / No flames. 3. Lack of water temperature control.				
Error codes when the valves fails	**111**	**121**	**510**	**701**	
Diagnostic	1. Visual inspection: connection/breakage of wires. 2. Listen for "clunk" sounds from the gas valves opening right after fan motor initiates. 3. Check voltages and resistance of coils; proper range of values shown below.				
Color/Number of wires	Blue - Light blue (MV)	78 to 100 VDC (during operation) / 0.9 to 1.3 kΩ			
	Blue - Green (SV_1)	78 to 100 VDC (during operation) / 1.3 to 1.9 kΩ			
	Blue - Orange (SV_2)	78 to 100 VDC (during operation) / 1.3 to 1.9 kΩ			
	Blue - Red (SV_3)	78 to 100 VDC (during operation) / 0.9 to 1.7 kΩ			
	White - Red (Proportional valve)	1.0 to 15 VDC (during operation) / 20 to 40 Ω			

Proportional Valve

EKH6T (for LP model) and EKK5K (for NA model) is an assembly of the gas manifold with gas valve assembly. For safety reasons, these assemblies should be installed in the unit as a whole set. The diagram below shows the gas valve assembly.

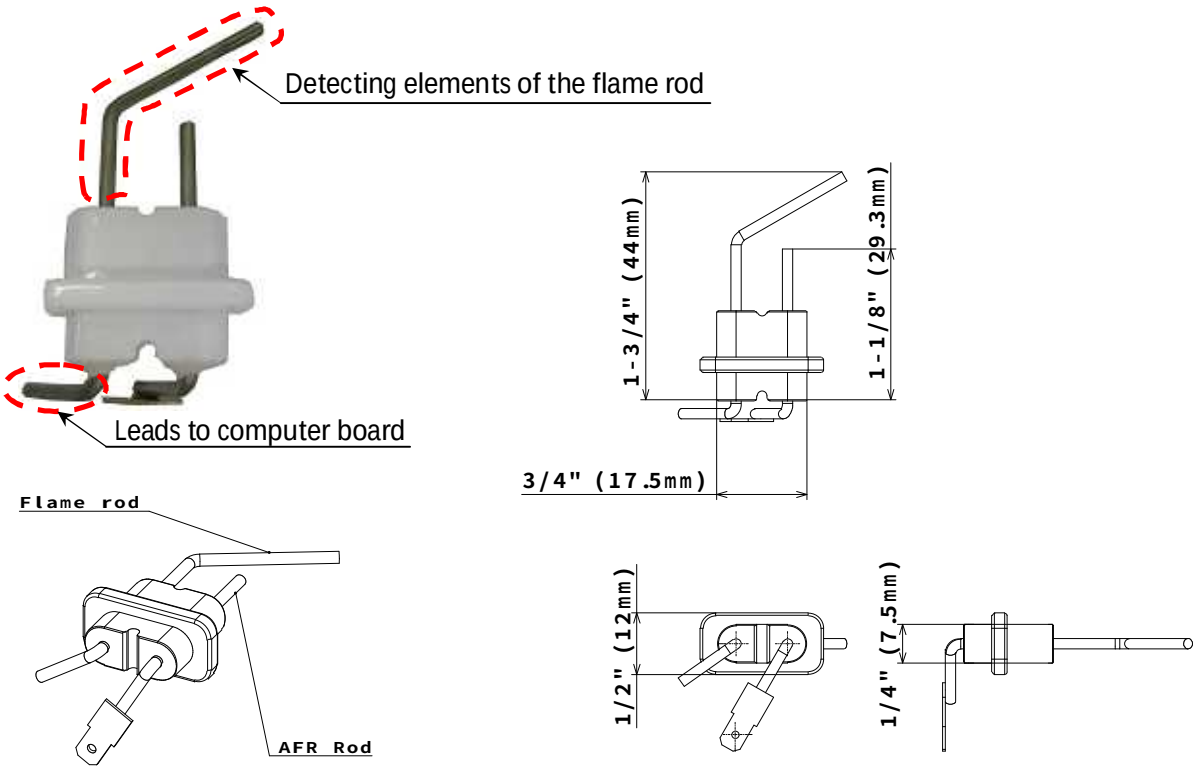




10-5. Flame rod

Unit Part #	#108	**Takagi Part** #	EKK0E	**Checkpoint**	I
Function	To detect flames while the water heater is in operation.				
Failure events	1. Unable to detect flames when flames actually do occur. 2. Detecting a false flame when no flames actually occur.				
Effects on the water heater if flame rod fails	1. The water heater stops operating. The "111" and/or "121" error code(s) will display. 2. The water heater will not initiate the ignition process. The "721" error code will display.				
Error codes when the flame rod fails	**111**		**121**		**721**
Diagnostic	1. Visual inspection: connection / breakage of wires or soot buildup on rod. 2. Check Amperes: proper range of values shown below.				
Color/Number of wires	Orange(17) - Flame rod (Between flame rod and the computer board)		(During operation) More than DC 1 μA		

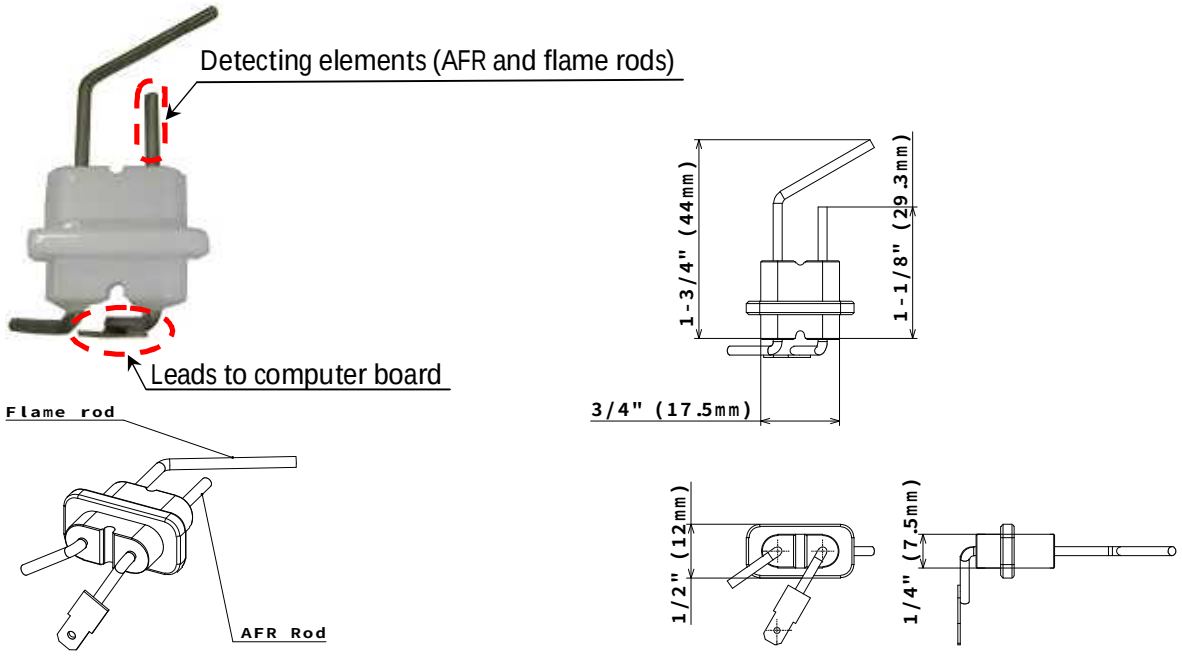
The flame rod is assembled with the AFR rod.



10-6. AFR rod

Unit Part #	#108	**Takagi Part** #	EKK0E	**Checkpoint**	I
Function	-Checks flame conditions during combustion. -When AFR rod detects unexpected flame conditions, the computer of the water heater makes adjustments in the fan motor speed to compensate.				
Failure events	1. Unable to detect flames when flames actually do occur 2. Detecting a false flame when no flames actually occur				
Effects on the water heater if AFR rod fails	1. The water heater will not initiate the ignition process. The "721" error code will display. 2. The fan motor speed cannot be modulated properly under abnormal flame conditions, which can result in excessive CO emission.				
Error codes when the AFR rod fails	**101** **391** **991**				
Diagnostic	1. Visual inspection: connection/braking of wires, soot on it. 2. Check voltages: proper range of values are shown below.				
Color/Number of wires	Yellow(8) - AFR rod (Between AFR rod and the computer board)		(During operation) More than DC 0.5 μA		

The AFR rod is assembled with the flame rod.

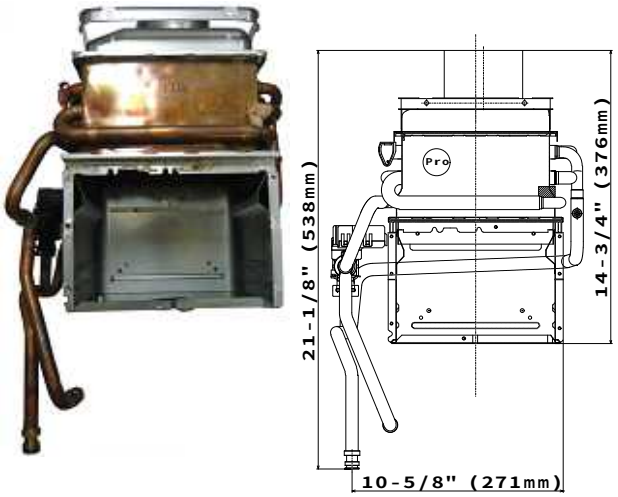


10-7. Heat exchanger

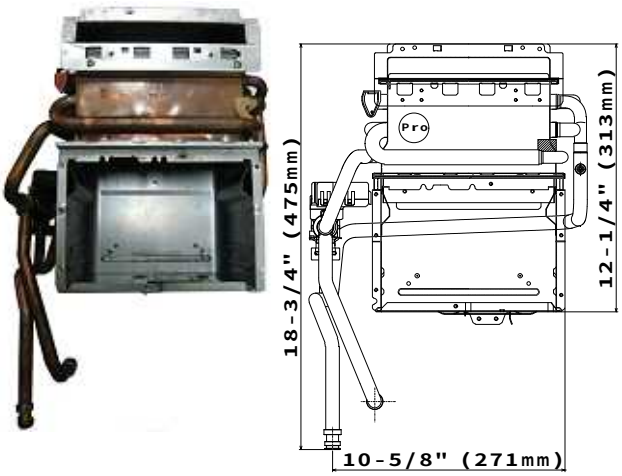
Unit Part #	#401	**Takagi Part** #	TU002 (IN) EK437 (OS)	**Checkpoint**	**N/A**
Function	Absorbs heat from combustion and transfer it to water through the heat exchanger pipes.				
Failure events	1. Clogged heat exchanger fins and/or cracks on the heat exchanger walls. 2. Leaking exhaust gas. 3. Improper heat transfer can cause the water in heat exchanger to boil.				
Effects on the water heater if the heat exchanger fails	1. Water leakage from the heat exchanger. 2. Exhaust gas leakage (if this occurs, an overheat cutoff fuse is in place to detect this event and immediately stop the water heater from operating) 3. Abnormal sounds during combustion .				
Error codes when the heat exchanger fails	**N/A**				
Diagnostic	1. Visual inspection: soot deposits, cracks on the heat exchanger walls, and/or water leakage from the heat exchanger. 2. In the event of abnormal sounds during combustion: A. Inspect for soot buildup inside the heat exchanger. B. Inspect for scale buildup inside the heat exchanger pipes. Scale buildup obstructs proper heat transfer to the water, thereby overheating the heat exchanger and causing damage.				
Color/Number of wires	**N/A**				

The heat exchanger of the T-D2-IN and T-D2-OS has the “Pro” mark as shown below.

T-D2-IN



T-D2-OS

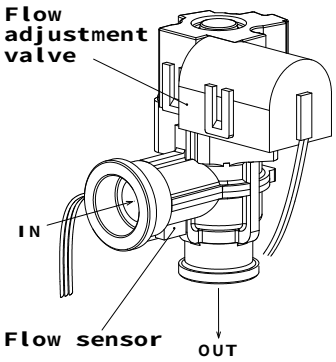


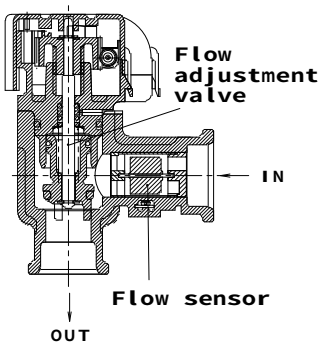
10-8. Flow adjustment valve

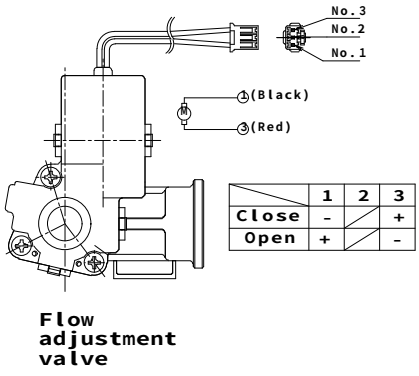
Unit Part #	#402	**Takagi Part #**	EK438	**Checkpoint**	J
Function	Controls water flow to properly control the output hot water temperature.				
Failure events	1. Water leakage from valve. 2. The valve cannot modulate or make open/close positions.				
Effects on the water heater if flow adjustment valve fails	1. Water leakage from failed valve can damage other water heater components. 2. Temperature fluctuations in the hot water output. 3. Within an Easy-Link system, the "651" error code can occur.				
Error codes when flow adjustment valve fails	**651 (only within Easy-Link systems)**				
Diagnostic	1. Visual inspection: connection/breakage of wires, motor drive locked due to scale buildup, and/or water leakage. 2. Check voltages and resistance; proper range of values shown below.				
Color/Number of wires	Black - Red 7 to 16 VDC and 0.09 to 0.2 kΩ				

The flow adjustment valve is assembled with the flow sensor.

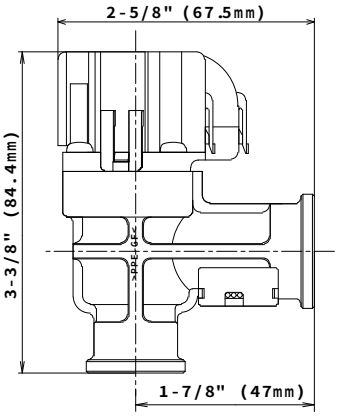
Flow adjustment valve







	1	2	3
Close	-		+
Open	+		-

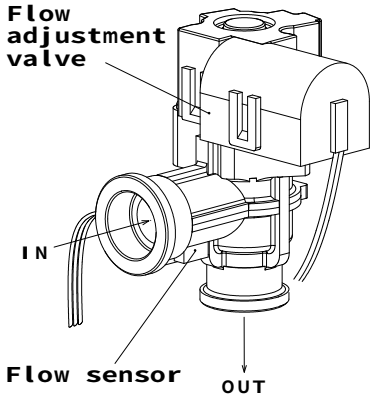


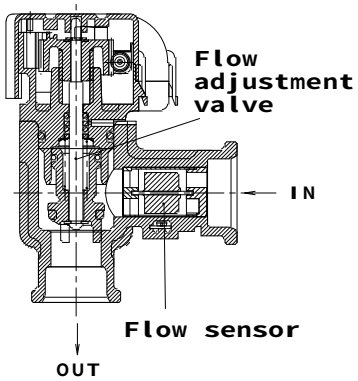
The flow adjustment valve differs from one in the T-K3-SP/OS.

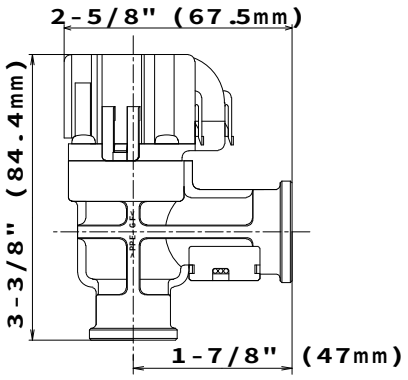
10-9. Flow sensor

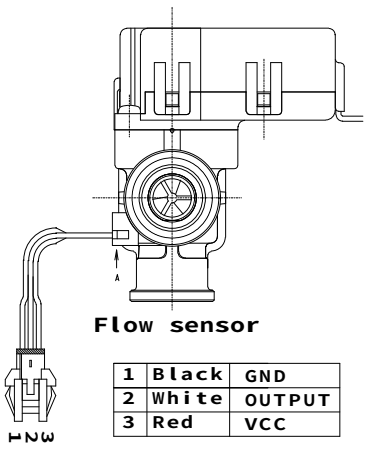
Unit Part #	#402	**Takagi Part #**	EK438	**Checkpoint**	**H2**
Function	Detects and measures water flow rate using a spinning impeller and magnetic pick-up.				
Failure events	Unable to detect or measure any water flow rate.				
Effects on the water heater if flow sensor fails	Ignition sequence does not start (water heater will not initiate any operation)				
Error codes when flow sensor fails	**441 (only within Easy-Link systems)**				
Diagnostic	1. Visual inspection: connection/breakage of wires and/or debris on impeller. 2. Check voltages: proper range of values shown below.				
Color/Number of wires	Red - Black	4.0 to 5.5 VDC (Input)			
	White(85) -Black	1.0 to 4.0 VDC (pulse) 1,080 pulse/min (more than 18 Hz)			

The flow sensor is assembled with the flow adjustment valve.







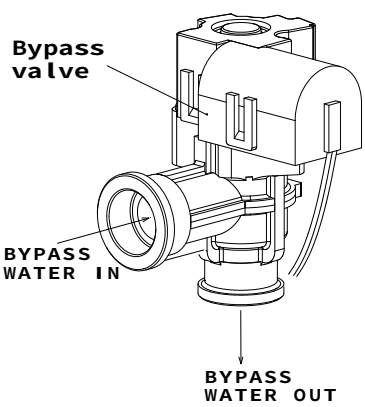


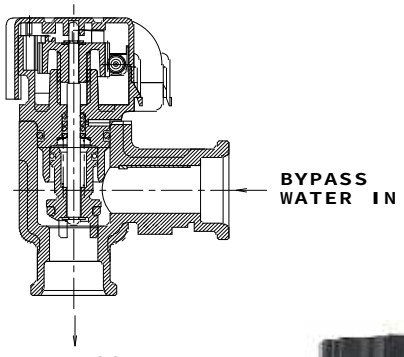
The flow senor differs from one in the T-K3-SP/OS.

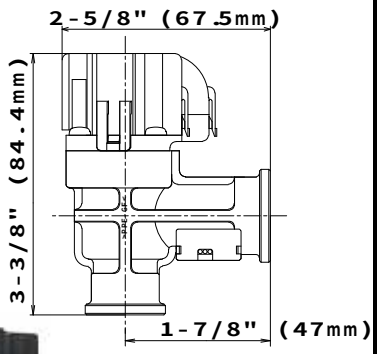
10-10. Bypass valve

Unit Part #	#403	**Takagi Part #**	EKK0U	**Checkpoint**	**J1**
Function	1. Mixes hot water from the heat exchanger with cold water from the water inlet in order to modulate and control the water heater's outlet water temperature. 2. Keeps the water temperature in the heat exchanger stable, preventing low-temperature corrosion by reducing condensation buildup in heat exchanger.				
Failure events	1. Water leakage from valve. 2. The valve cannot modulate properly.				
Effects on the water heater if bypass valve fails	1. Water leakage from failed valve can damage other water heater components. 2. Temperature fluctuations in the hot water output.				
Error codes when bypass valve fails	**N/A**				
Diagnostic	1. Visual inspection: connection/breakage of wires. 2. Check voltages and resistance: proper range of values shown below.				
Color/Number of wires	Red - Black 7 to 16 VDC and 0.09 to 0.2 kΩ				

The physical appearance of the bypass valve is similar to that of the flow adjustment valve. However, their functions differ and cannot be substituted for each other.

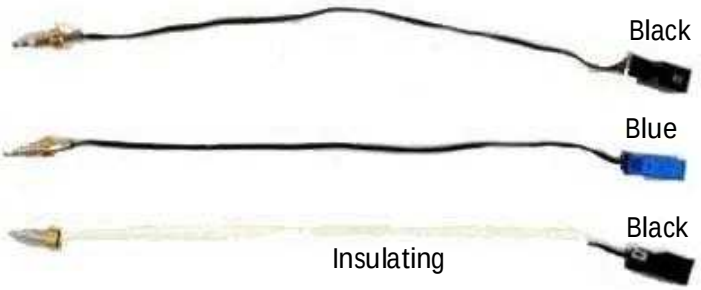




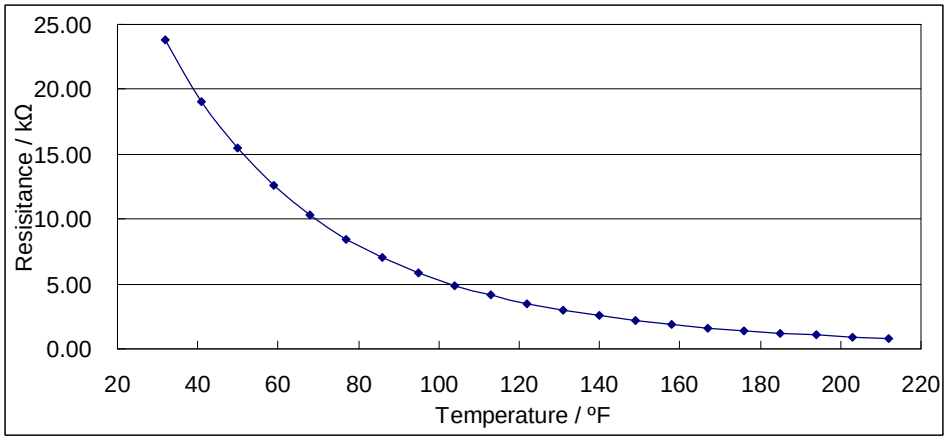


10-11. Thermistors

Unit Part #	#407 (Inlet) #408 (Mixing) #411 (Output)	**Takagi Part #**	EKK38 (Inlet) EKK1A (Mixing) EKK2T (Output)	**Checkpoint**	**E1 (Mixing)** **E2 (Output)** **E3 (Inlet)**
Function	Measures cold/hot water temperatures in the water heater.				
Failure events	Unable to properly measure water temperatures within the water heater.				
Effects on the water heater if thermistor fails	If the thermistors fail open or short, error code appears before starting operation. If resistance values are just off, The water heater will have temperature fluctuations in hot water.				
Error codes when thermistors fails	**311 (Output)**		**321 (Inlet)**		**331 (Mixing)**
Diagnostic	1. Visual inspection: connection/breakage of wires and/or debris on thermistor. 2. Check voltages and resistance; proper range of values shown below.				
Color/Number of wires	Inlet Black(42)-Black Output Black(12)-Black Mixing Black(113)-Black		68˚F (20°C) 9.0 to 13 kΩ 122˚F (50°C) 3.3 to 4.4 kΩ 176˚F (80°C) 1.4 to 1.8 kΩ (see table below for more resistance values)		



Resistance values of thermistors as a function of temperature

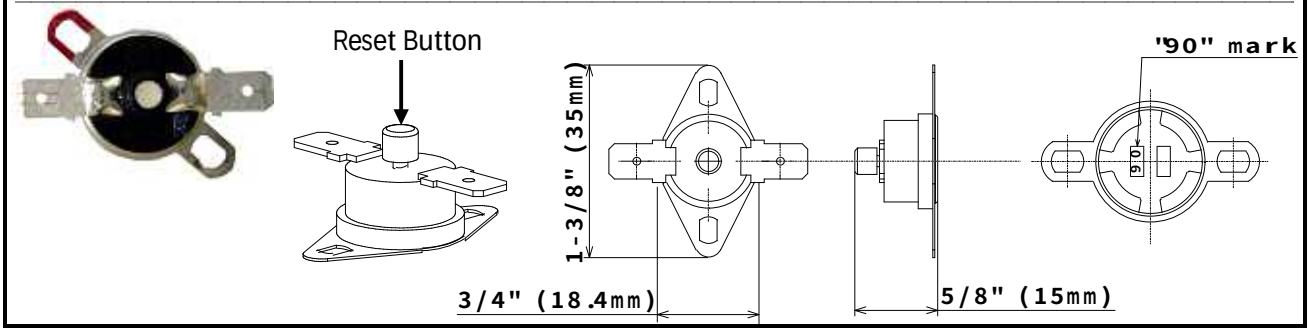


10-12. Hi-limit switch

Unit Part #	#412	**Takagi Part** #	EKN34	**Checkpoint**	**C1**
Function	-Based on bi-metal thermal expansion. -Detects excessively high water temperature (more than 194˚F or 90˚C) in pipes of the heat exchanger. -After detection, communication between the computer board and gas valves are severed, shutting down the water heater instantly. The "111" or "121" error codes will display.				
Failure events	1. Unable to detect excessively high water temperatures if switch fails "closed". 2. Continuous detection of excessively high water temperatures (regardless of what the actual water temperature is) if switch fails "open".				
Effects on the water heater if hi-limit switch fails	1. Unable to shut down the water heater if the water temperature from the heat exchanger exceeds 194˚F (90˚C). Note: The mixing and output thermistors always act as backup hi-limit detectors to detect excessively high water temperatures in the heat exchanger. 2. The water heater is always shut down immediately after the ignition process, and either the "111" or "121" error code will display.				
Error codes when hi-limit switch fails	**111** **121** **The T-D2-IN / T-D2-OS don't have the "141" error code that was used in our previous models. This error code is now replaced by the "111" and the "121" error codes.**				
Diagnostic	1. Visual inspection: connection/breakage of wires. Possibility also includes scale deposits inside the heat exchanger. 2. Check voltages and resistance: proper range of values shown below.				
Color/Number of wires	Blue-Blue Less than 1.0 Ω				

When temperatures exceed 194˚F (90˚C), the reset button trips and switch goes to OFF mode.

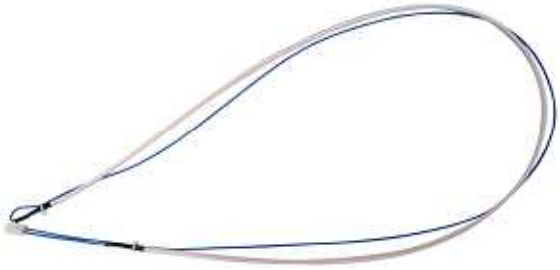
ON mode : <194˚F (90˚C) OFF mode: to reset switch back to ON mode, press the reset button

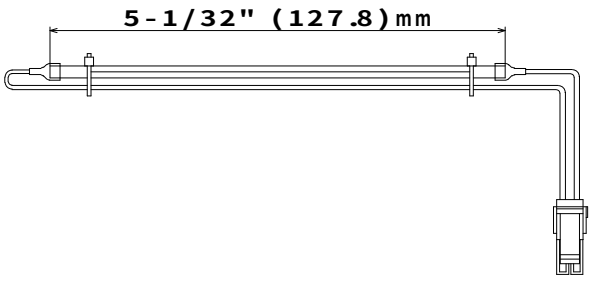


10-13. Overheat cut off fuse

Unit Part #	#413	**Takagi Part** #	EK333	**Checkpoint**	**C2**
Function	-The overheat cutoff fuse contains solder with a melting point of 430˚F (221˚C). -Detects excessive temperatures within the water heater, especially around the heat exchanger and combustion chamber. Upon detection, communication between the computer board and gas valves will sever, shutting down the water heater instantly. The "111" or "121" error code will display.				
Failure events	1. Unable to detect the excessively high temperatures within the water heater.				
Effects on the water heater if the overheat cutoff fuse fails	1. Flames from burner may penetrate a ruptured/damaged heat exchanger. 2. Gas valves will not operate.				
Error codes when the overheat cutoff fuse fails	**111**		**121**		
Diagnostic	1. Visual inspection: connection/breakage of wires. 2. Check voltages and resistance: proper range of values shown below.				
Color/Number of wires	Blue-Blue Less than 1.0 Ω				

Solder will melt at temperature exceeding 430˚F (±9˚F) or 221˚F (±5˚C)



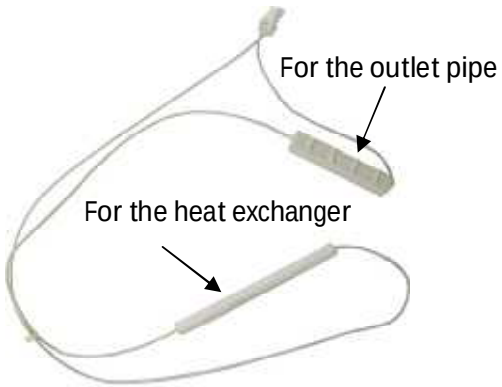


The O.H.C.F. has a red line on itself.

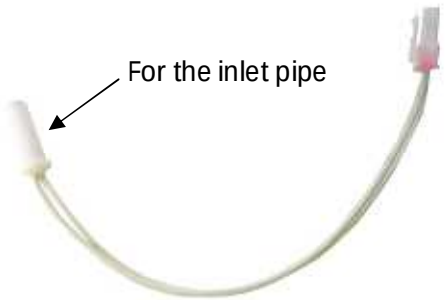
10-14. Freeze protection heaters

Unit Part #	#414 #415	**Takagi Part #**	EKK2R EKK2P	**Checkpoint**	**B1**
Function	Prevents the heat exchanger, water valves, and water pipes within the water heater from freezing. The heaters are but one of the freeze protection devices in the water heater.				
Failure events	Open circuit failure: Ceramic heaters do not receive the voltage needed to heat up.				
Effects on the water heater if heater fails	Ceramic heaters do not activate, allowing water contained in the heat exchanger to freeze up, possibly causing the heat exchanger to burst.				
Error codes when heaters fails	**N/A**				
Diagnostic	1. Visual inspection: connection/breakage of wires and the condition of the heaters. 2. Check: whether those are in the normal range as shown in the following table.				
Color/Number of wires	Black - Black 90 to 110 VAC (during freeze protection operation)				

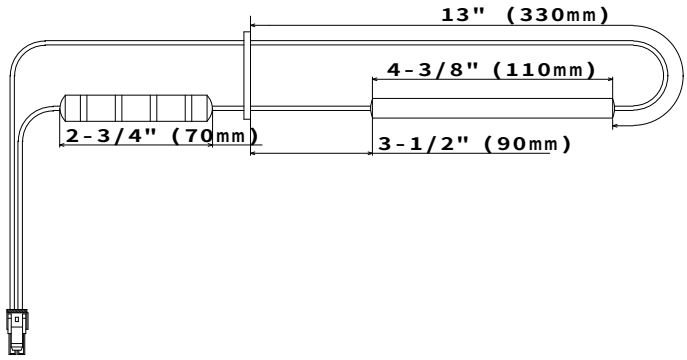
The water heater has two types of the heaters in it. The one is for protecting of the heat exchanger and the outlet pipe, the other one is for protecting of the inlet pipe.

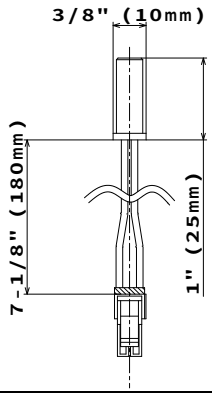


(Part# 414 / EKK2R)



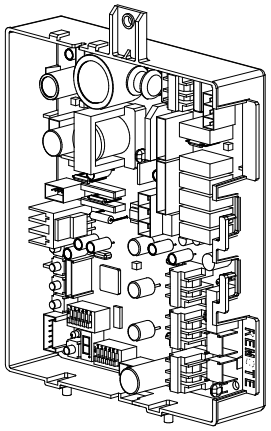
(Part# 415 / EKK2P)

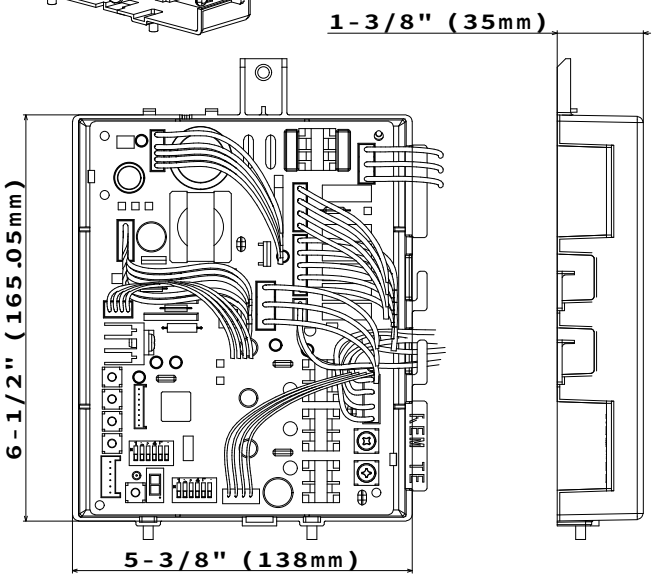




10-15. Computer board

Unit Part #	#701	**Takagi Part** #	EK439	**Checkpoint**	**N/A**
Function	Controls the functions of most of the parts in the water heater.				
Failure events	Malfunctioning computer				
Effects on the water heater if the computer board fails	-A component(s) may not operate within the water heater. In most cases of computer board failure, the whole the water heater does not operate at all. -Error codes will display.				
Error codes when the computer board fails	**701**	**721**	**741**	**761**	
Diagnostic	Visual inspection: connection/breakage of wires and/or burn marks on the computer board.				
Color/Number of wires	**N/A**				

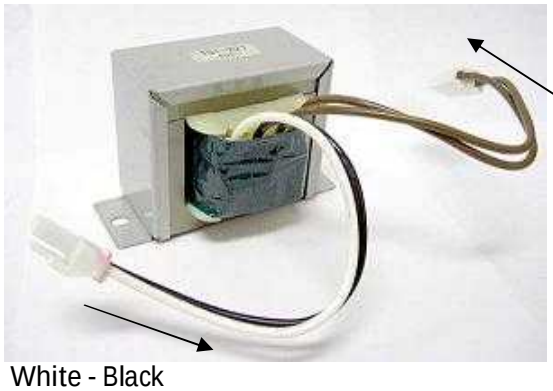




The computer board differs from one in the T-K3-SP/OS.

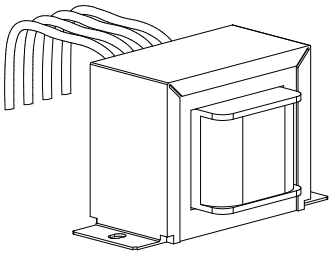
10-16. Transformer

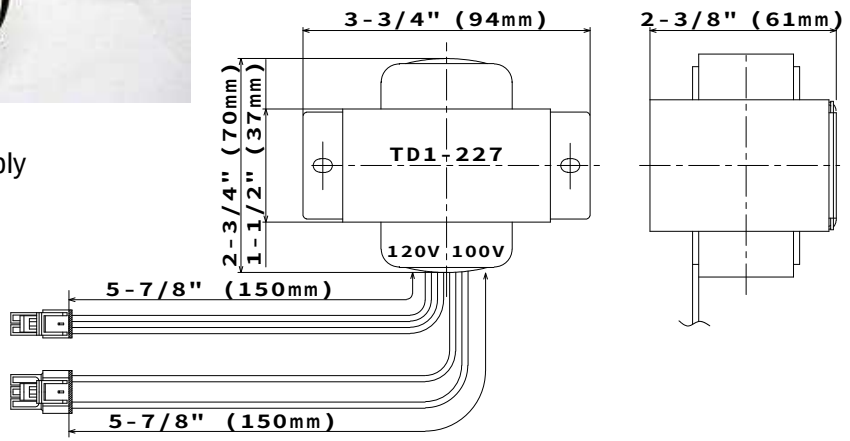
Unit Part #	#702	**Takagi Part #**	EKH09	**Checkpoint**	**A1,A2**
Function	-To transform input voltage from 120 to 100 VAC. -Every electrical component of the water heater is designed to only work with a 100 VAC power supply, therefore, the water heater comes equipped with this transformer.				
Failure events	1. There is no power coming from the transformer. 2. The voltage from the power supply cannot be converted to 100 VAC.				
Effects on the water heater if transformer fails	1. The water heater does not operate due to lack of power from transformer. 2. A failed transformer can cause electrical damage to other electrical components within the water heater.				
Error codes when transformer fails	**N/A**				
Diagnostic	1. Visual inspection: connection/breakage of wires and/or signs of electrical damage. 2. Check voltages of the transformer: Proper range of values shown below.				
Color/Number of wires	White – Black	120 VAC / less than 1 Ω			
	Brown – Brown	100 VAC / less than 1 Ω			



White - Black
From the 120 VAC power supply

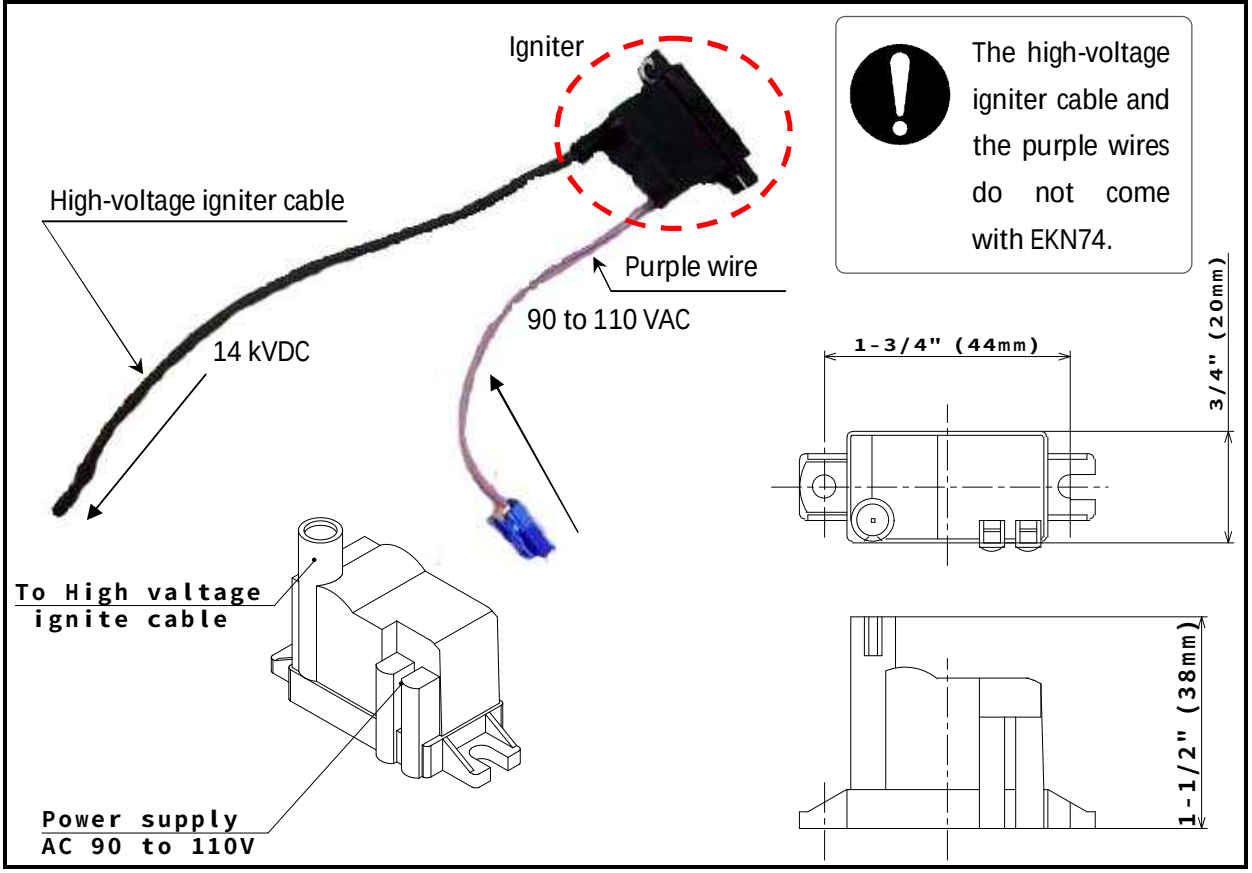
Brown - Brown
To power computer board and heaters
(100 VAC)





10-17. Igniter

Unit Part #	#711	**Takagi Part #**	EKN74	**Checkpoint**	**B**
Function	-To ignite the gas/air mixtures when the water heater is ready to burn gas on its burner surface. -The output voltage of the igniter is more than 14 kVDC.				
Failure events	1. Unable to ignite during the ignition process. 2. Makes attempts to ignite at all times.				
Effects on the water heater if the igniter fails	1. The water heater cannot ignite during the ignition process and the "111" or "121" error codes will display. 2. No effects on the water heater, however, the durability of the igniter wears down.				
Error codes when Igniter fails	**111**			**121**	
Diagnostic	1. Visual inspection: connection/breakage of wires and/or an observed weak spark. 2. Check voltages: proper range of values shown below.				
Color/Number of wires	Purple(7)-Purple(7) 90 to 110 VAC				

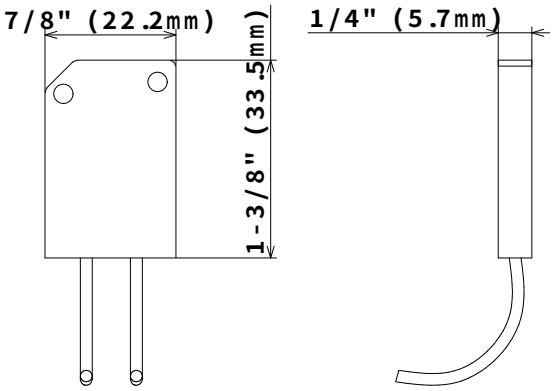


10-18. Freeze protection thermostat

Unit Part #	#713 #710	**Takagi Part #**	EKJ59 (IN) EKK40 (OS)	**Checkpoint**	**B1**
Function	Temperature detecting device which prevents the pipes within the water heater from freezing. When this device detects temperatures below 36.5˚F (2.5˚C) inside the water heater, power is supplied to the electric heaters to prevent the water heater from freezing.				
Failure events	1. ON-failure (Always senses freezing temperatures, regardless of actual temperature). 2. OFF-failure (Never senses freezing temperatures).				
Effects on the water heater if the freeze protection thermostat fails	1. The freeze protection heaters will always be ON, causing heat damage to components inside the water heater. 2. The freeze protection heaters will never be able to turn on, even under freezing temperatures, causing freeze damage to the water heater.				
Error codes when the freeze protection thermostat fails	**N/A**				
Diagnostic	1. Visual inspection: connection/breakage of wires and/or the body has been broken. 2. Check resistance and voltage: proper range of values shown below.				
Color/Number of wires	Black - Black (itself)	ON mode: 90 to 110 VAC and less than 1 Ω OFF mode: less than 1 VAC and more than 1 MΩ			

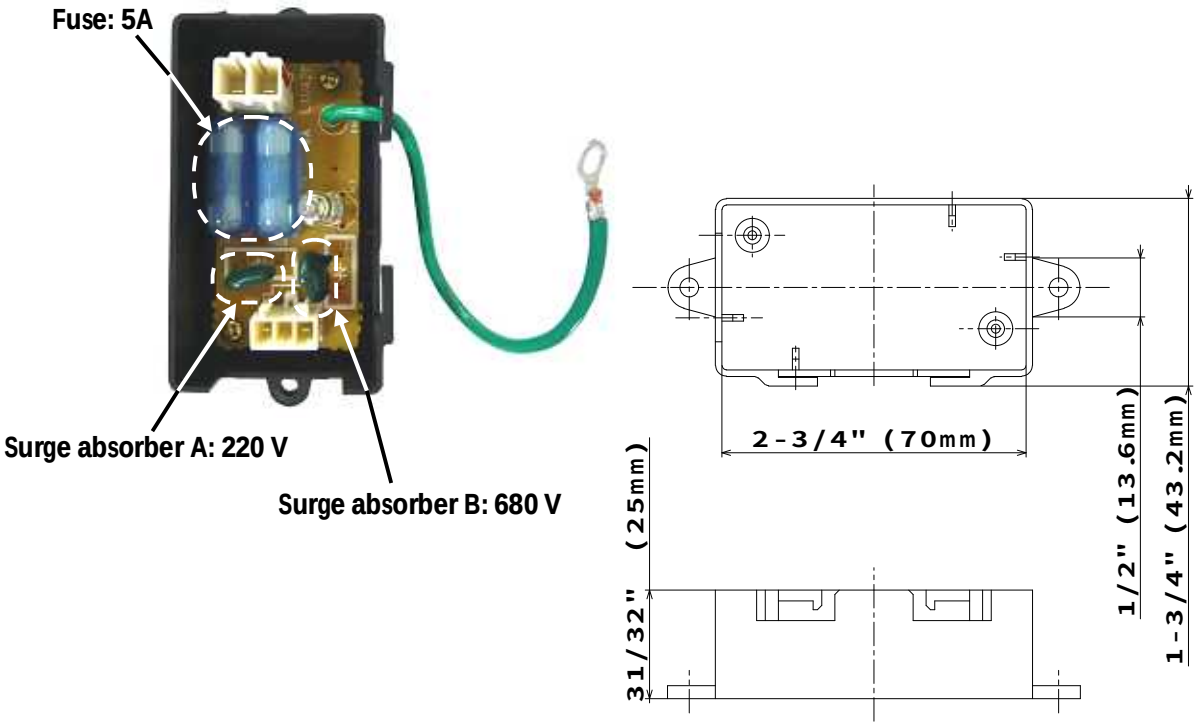
Activation and deactivation temperature of the water heater's freeze protection system

ON mode: 36.5˚F (+6.3˚F -2.7˚F)	2.5˚C (+3.5˚C -1.0˚C)
OFF mode: above 46.4˚F	above 8 ˚C



10-19. Surge box

Unit Part #	#703	**Takagi Part** #	EK428	**Checkpoint**	**A2,A3**
Function	Protects the unit from high voltage and/or high electric current caused by lightning. There are 2 types of surge absorbers in the water heater. Surge absorber A is activated by voltage higher than 220V, the other one is activated by voltage higher than 680V.				
Failure events	1. Open-failure of the absorber and/or fuse. 2. Short-failure of the absorber.				
Effects on the water heater if the fuse box fails	1. Unable to protect the computer board if high voltage gets applied to the unit. The computer board can short out, stopping all operations. 2. The unit cannot operate because the absorber shorted out, causing the fuse to break open.				
Error codes when the surge box fails	**N/A**				
Diagnostic	1.Visual inspection: burn marks on components and/or connection/breakage of wires. 2. Check resistance and voltage: proper range of values shown below.				
Color/Number of wires	White-Black 108 to 132 VAC				



11. Fault Analysis & Specifications

Remarks:
1. Proper range of values of voltage & resistance shown below.
2. Please refer to the wiring diagram for checkpoint positions.
3. Remove power to the water heater when checking for continuity, disconnections, resistance values, etc.

Natural of Fault	Diagnosis	Check point
• No display on temperature remote controller, even when remote is turned on.	1 Check the power supply [1] Check the power supply from Power ON-OFF switch to the PCB **(Refer to section12-2)** [2] Check the power supply line to the water heater	
	2 Fault of Power ON-OFF switch Normal: 100 VAC between (white-black) Normal: 100 VAC between (brown-brown)	 A A1
	3 Fault of transformer [1] Disconnection / breakage of wires Normal: 120 VAC between (white-black) Normal: 100 VAC between (brown-brown)	 A2 A1
	4 Blown fuse at surge box (3A)	A2
	5 Fault of PCB [1] No voltage at remote control terminal Normal: 11 to 25 VDC between (white-black)	 F
	6 Disconnection/short-circuit/grounding of remote wires Normal: 11 to 25 VDC between (white-black)	
	7 Fault of PCB of remote control [1] Check for normal voltage at terminal	
•It takes long time to get hot water at the fixtures	1 The time it takes to deliver hot water from the water heater to fixtures depends on the length of piping between them. The longer the distance or the bigger the pipes, the longer it will take to get hot water. 2 If you need hot water to fixtures quicker, you may want to consider a hot water recirculation system.	
• The water is not hot enough	1 Check cross pluming between cold water lines and hot water lines. 2 Check whether the gas supply pressure is enough. 3 Check whether the temperature setting is too low.	
• The water is too hot	1 Check whether the temperature setting is too high.	
• The hot water is not available when a fixture is opened	1 Make sure the unit has a 120 VAC / 60 Hz power supply. 2 If the remote controller is used, check whether the power button is turned on. 3 Check that the filter on the cold water inlet is clean. 4 Check whether the hot water fixture is sufficiently open to draw at least 0.5 GM through the water heater.	

Natural of Fault	Diagnosis	Checkpoint
• The hot water is not available when a fixture is opened	5 Check that the filter on the cold water inlet is clean. 6 Check whether or not the unit is frozen. 7 Check if there is enough gas in the tank. (for propane units)	
•The hot water turns cold and stays cold	1 Check whether the flow rate is high enough to keep the water heater running. 2 Check if there is a recirculation system installed and check also if the recirculation line has enough check valves. 3 Check that the filter on the cold water inlet is clean. 4 Check that the fixtures are free from debris and obstructions.	
• The fan motor is still spinning after operation has stopped	1 This is normal operation. After operation has stopped, the fan motor keeps its running 15 to 70 seconds in order to re-ignite quickly, as well as purge all the exhaust gas out of the flue.	
• Abnormal sound from water heater	1 Check the gas type of the water heater. 2 Check how long the water heater has been installed and in use. 3 Check the installation place. 4 Check the altitude/elevation of area of where the water heater installed. 5 Check the vent length, when the water heater has been installed indoors. 6 Check if there is any blockage in the intake air and/or exhaust. 7 Check if there is dust and lint in burner and heat exchanger, when the water heater has been installed in laundry room. 8 Check if there is grease and dirt in burner and fan motor, when the water heater has been installed in restaurant. 9 Check the manifold pressure in the water heater.	

Natural of Fault	Malfunction description	Cancellation method
• Fluctuation of hot water temperature	-Fault of gas solenoid valves (SV_1 & SV_3) during change of the combustion stage -Fault of flow adjustment valve	
	Diagnosis	**Checkpoint**
	1 Check whether the filter in cold water inlet is cleaned. 2 Check whether the gas supply pressure is adequate. 3 Check for cross connections between cold water lines and hot water lines.	

Natural of Fault	Diagnosis	Checkpoint
• Fluctuation of hot water temperature	4 Fault of PCB in the water heater [1] No voltage to gas solenoid valve (SV_1). Normal: 78 to 100 VDC between COM (blue) & #9 (green) (during operation) [2] No voltage to gas solenoid valve (SV_3). Normal: 78 to 100 VDC between COM (blue) & #73 (red) (during operation)	C
	5 Gas solenoid valve (SV_1) fault [1] Disconnected wiring to gas solenoid valve (SV_1) Normal: 1.3 to 1.9 kΩ between COM (blue) & #9 (green) [2] Disconnected wiring to gas solenoid valve (SV_3) Normal: 0.9 to 1.7 kΩ between COM (blue) & #73 (red)	C
	6 Fault of PCB in the water heater No voltage flow adjustment valve Normal: 7 to 16 VDC between (red-black)	J
	7 Flow adjustment valve fault Normal: 0.09 to 0.2 kΩ between (red-black)	J

Error Code	Malfunction description	Cancellation method
031	Incorrect dipswitch setting fault	Turn off the power or water supply
	Diagnosis	**Checkpoint**
	Check the dipswitch settings on PCB	

Error Code	Malfunction description	Cancellation method
101	Warning for the “991” error code **(Refer to section 12-3)**	On the PCB, press the INC and DEC buttons simultaneously for 3 sec. Then turn the power off.
	Diagnosis	**Checkpoint**
	1 Check the gas type of the water heater. 2 Check how long the water heater has been installed and in use. 3 Check the installation location. 4 Check the altitude/elevation of area of where the water heater installed. 5 Check the vent length. 6 Check if there is any blockage in the intake air and/or exhaust. 7 Check if there is dust and lint in burner and heat exchanger, when the water heater has been installed in laundry room.	

Error Code	Diagnosis	Checkpoint
101	8 Check if there is grease and dirt in burner and fan motor, when the water heater has been installed in restaurant. 9 Check the manifold pressure in the water heater.	

Error Code	Malfunction description	Cancellation method
111	Ignition failure	Turn off the power or water supply
	Diagnosis	**Checkpoint**
Error code is shown after three failed attempts at ignition	1 Check gas supply and inlet gas pressure **(Refer to section 1)**	
	2 Check the igniter **(Refer to section 10-17)** Visual inspection: connection/breakage of wires and/or observed weak spark. [1] Cracks/soot on igniter rod [2] Improper gap between burner & igniter rod Normal gap: 0.16" (4mm) [3] PCB fault Normal: 90 to 110 VAC at #7 (purple-purple) (during ignition) 3 PCB fault [1] No voltage to main gas solenoid valve (MV) Normal: 78 to 100 VDC between COM (blue) & #3 (light blue) (during operation) [2] No voltage to gas solenoid valve (SV_2) Normal: 78 to 100 VDC between COM (blue) & #53 (orange) (during operation) [3] No voltage to gas proportional valve (VG_0) Normal: 1 to 15 VDC between white & red (during operation)	B C H1
	4 Gas solenoid valve fault [1] Main gas solenoid valve (MV) fault Normal: 0.9 to 1.3 kΩ between COM (blue) & #3 (light blue) [2] Gas solenoid valve (SV_2) fault Normal: 1.3 to 1.9 kΩ between COM (blue) & #53 (orange) [3] Gas proportional valve (VG_0) fault Normal: 1 to 15 VDC between white & red (during operation)	C H1

Error Code	Diagnosis	Checkpoint
111 Error code is shown after three failed attempts at ignition	5 Disconnected/damaged O.H.C.F. **(Refer to section 10-13)** Visual inspection: connection/breakage of wires. Normal: 1 Ω or less between blue & blue	C2
	6 Disconnected/damaged hi-limit switch. **(Refer to section 10-12)** Visual inspection: connection/breakage of wires. Normal: 1 Ω or less between blue & blue	C1
	7 Inspect flame rod [1] Check for any soot on the rod. [2] Check the connection of ground wire; make sure there is firm contact to the ground of the water heater. (in this case, the wire is contacted to the manifold surface.) [3] PCB fault During operation: more than 1 μA through the flame rod wire (orange) [4] Flame rod fault During operation: more than 1 μA through the flame rod wire (orange)	I
	8 Check if hi-limit switch is properly functioning.	

Error Code	Malfunction description	Cancellation method
121 Error code is shown after three failed attempts at ignition	Loss of flame	Turn off the power or water supply
	Diagnosis	**Checkpoint**
	1 Check gas supply and pressure **(Refer to section 1)**	
	2 PCB fault [1] No voltage to gas main solenoid valve (MV) Normal: 78 to 100 VDC between COM (blue) & #3 (light blue) (during operation) [2] No voltage to gas solenoid valve (SV_2) Normal: 78 to 100 VDC between COM (blue) & #53 (orange) (during operation) [3] No voltage to gas proportional valve (VG_0) Normal: 1 to 15 VDC between white & red (during operation)	C H1
	3 Gas solenoid fault [1] Main gas solenoid valve (MV) fault Normal: 0.9 to 1.3 kΩ between COM (blue) & #3 (light blue) [2] Gas solenoid valve (SV_2) fault Normal: 1.3 to 1.9 kΩ between COM (blue) & #53 (orange) [3] Gas proportional valve (VG_0) fault Normal: 1 to 15 VDC between white & red	C H1

Error Code	Diagnosis	Checkpoint
121 Error code is shown after three failed attempts at ignition	4 Check for soot on the flame rod [1] Clean the flame rod [2] PCB fault During operation: more than 1 μA through the flame rod wire (orange)	I
	5 Disconnected/damaged O.H.C.F. **(Refer to section 10-13)** Visual inspection: connection/breakage of wires. Normal: 1 Ω or less between blue & blue	C2
	6 Check if hi-limit switch is properly functioning.	
	7 Disconnected/damaged hi-limit switch. **(Refer to section 10-12)** Visual inspection: connection/breakage of wires. Normal: 1 Ω or less between blue & blue	C1

Error Code	Malfunction description	Cancellation method
311	Disconnected/short-circuited output thermistor	Turn off the power or water supply
	Diagnosis	**Checkpoint**
	1 Output thermistor fault **(Refer to section 10-11)** Visual inspection: connection/breakage of wires and/or debris on thermistor. Check voltage/resistance between black & black (#12). Refer to Section 8 for proper range of values.	E2

Error Code	Malfunction description	Cancellation method
321	Disconnected/short-circuited inlet thermistor	Turn off the power or water supply
	Diagnosis	**Checkpoint**
	1 Inlet thermistor fault **(Refer to section 10-11)** Visual inspection: connection/breakage of wires and/or debris on thermistor. Check voltage/resistance between black & black (#42). Refer to Section 8 for proper range of values.	E3

Error Code	Malfunction description	Cancellation method
331	Disconnected/short-circuited mixing thermistor	Turn off the power or water supply
	Diagnosis	**Checkpoint**
	1 Mixing thermistor fault **(Refer to section 10-11)** Visual inspection: connection/breakage of wires and/or debris on thermistor. Check voltage/resistance between black & black (#113). Refer to Section 8 for proper range of values.	E1

Error Code	Malfunction description	Cancellation method
391	Disconnected AFR rod	Turn off the power or water supply
	Diagnosis	**Checkpoint**
	1 AFR rod fault **(Refer to section 10-6)** Visual inspection: connection/breakage of wires, soot on it.	I

Error Code	Malfunction description	Cancellation method
441	Flow sensor failure (Only Easy-link system)	Turn off the power or water supply
	Diagnosis	**Checkpoint**
	1 Flow sensor failure **(Refer to section 10-9)** Visual inspection: connection/breakage of wires and/or debris on impeller. Check voltage/resistance between (red & black) or (white & black)	H2

Error Code	Malfunction description	Cancellation method
510	Fault of driving circuit for main gas solenoid valve (MV, SV_1, SV_2 and/or SV_3) (The computer checks the condition of the main gas valve immediately after every operation and the conditions of the solenoid valves 6 hours after every operation)	Turn off the power supply
	Diagnosis	**Checkpoint**
	1 PCB and/or main gas valve fault **(Refer to section 10-4 & 10-15)** Visual inspection of gas valves: connection/breakage of wires. Normal: 78 to 100 VDC between COM (blue) & #3 (light blue) (during operation) Normal: 78 to 100 VDC between COM (blue) & #9 (green) (during operation) Normal: 78 to 100 VDC between COM (blue) & #53 (orange) (during operation) Normal: 78 to 100 VDC between COM (blue) & #73 (red) (during operation) Visual inspection of PCB: connection/breakage of wires and/or burn marks on the computer board. 2 Gas solenoid valve fault (MV, SV_1, SV_2 and/or SV_3)	C

Error Code	Malfunction description	Cancellation method
611	Fan motor fault	Turn off the power or water supply
	Diagnosis	**Checkpoint**
	1 PCB and fan motor fault **(Refer to section 10-3 & 10-15)** Visual inspection of fan motor: connection/breakage of wires or dust buildup (causing electrical shortage) Normal: 110 to 160 VDC between red & blue (during operation) Normal: 13 to 17 VDC between yellow & blue (during operation) Normal: 2.0 to 6.5 VDC between orange & blue (during operation) Verify fan motor speed of the water heater using the "diagnostics mode" of the TM-RE30 temperature remote controller. See the "12-1. How to diagnose the water heater using the TM-RE30". Visual inspection of PCB: connection/breakage of wires and/or burn marks on the computer board.	G

Error Code	Malfunction description	Cancellation method
651	Flow adjustment valve fault (Only Easy-link system)	Turn off the power or water supply
	Diagnosis	**Checkpoint**
	1 PCB and flow adjustment valve fault **(Refer to section 10-8 & 10-15)** Visual inspection of flow adjustment valve: connection/breakage of wires, motor drive locked due to scale buildup, and/or water leakage. Normal: 7 to 16 VDC between (black-red) Visual inspection PCB: connection/breakage of wires and/or burn marks on the computer board.	J

Error Code	Malfunction description	Cancellation method
701	1 PCB fault [1] Fault of preparation for the mixing thermistor operation. [2] Fault of driving circuit for Gas Proportional Valve(VG_0)	Turn off the power or water supply
	Diagnosis	**Checkpoint**
	1 Check the PCB and/or gas proportional valve **(Refer to section 10-4 & 10-15)** Visual inspection PCB: connection/breakage of wires and/or burn marks on the computer board. Visual inspection gas proportional valve: connection/breakage of wires of the gas proportional valve. Normal: 20 to 40 Ω between (white) & (red)	H1

Error Code	Malfunction description	Cancellation method
721	False flame detection	Turn off the power or water supply
	Diagnosis	**Checkpoint**
	1 False flame detection (5 sec.) Flame rod (Insulated resistance) fault	I

Error Code	Malfunction description	Cancellation method
741	Miscommunication between water heater and temperature remote controller	Restoring proper cable connections between the water heater and the Remote controller (TM-RE30). When the computer detects proper connections between the water heater and the remote controller, "741" error code will cease to display.
	Diagnosis	**Checkpoint**
	1 Temperature remote controller (TM-RE30) or PCB fault 2 Check for signs of power surges.	

Error Code	Malfunction description	Cancellation method
761	Miscommunication between Parent and Child units for Easy Link systems.	Restoring proper cable connections among all the water heaters. When the computer detects proper connections among all the water heaters, "761" error code will cease to display.
	Diagnosis	**Checkpoint**
	1 Inspect cable connections between Parent and Child units. 2 Check for signs of power surges.	

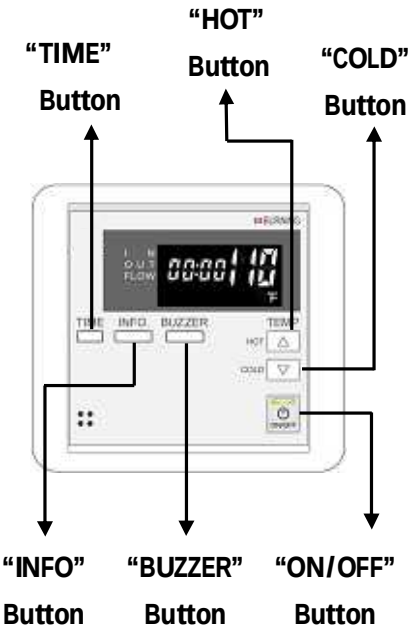
Error Code	Malfunction description	Cancellation method
991	Imperfect combustion **(Refer to section 12-3)**	Turn off the power or water supply If not possible, press and hold the INC and DEC buttons on the computer board simultaneously for more than 3 sec.
	Diagnosis	**Checkpoint**
	1 Check the gas type of the water heater. 2 Check how long the water heater has been installed and in use. 3 Check the installation place. 4 Check the altitude/elevation of area of where the water heater installed. 5 Check the vent length. 6 Check if there is any blockage in the intake air and/or exhaust. 7 Check if there is dust and lint in burner and heat exchanger, when the water heater has been installed in laundry room. 8 Check if there is grease and dirt in burner and fan motor, when the water heater has been installed in restaurant. 9 Check the manifold pressure in the water heater.	

12. Controls and settings

12-1. Diagnosis using the TM-RE30

< Individual unit>

1. Press the "**HOT**" button and the "**COLD**" button simultaneously for at least 5 seconds to enter "Diagnostic mode".
2. Scroll up or down to the needed information (mode #) of the T-D2-IN or T-D2-OS by pressing the "**HOT**" or "**COLD**" buttons (Fig.1 shows mode #5 being selected.)
   When selecting information, please refer to the table on p. 49 for the proper mode #.
3. Press the "**INFO**" button to select the mode #, and the information to which the mode # correlates to will display on the TM-RE30 (Fig.2).
4. When the "**ON/OFF**" button is pressed or 5 minutes have elapsed without pressing any buttons, the display will return to normal.



Mode #

Fig.1

Information

Fig.2

< For multiple units in an Easy-Link system >

1. Press and hold the "**HOT**" and "**COLD**" buttons simultaneously for at least 5 seconds to enter "Diagnostics Mode".
2. "0" will be displayed on the TM-RE30. (See Fig. 1)
3. Scroll to the desired T-D2-IN or T-D2-OS unit # in the easy-link system by pressing the "**HOT**" or the "**COLD**" buttons to scroll up or down. (Fig. 2 shows that unit #2 is being selecting)

NOTE: The definition of the unit #'s:

"0" will yield information about the Easy-link system as a whole, and numbers "1", "2", "3", & "4" will yield information about each of the individual T-D2-IN or T-D2-OS installed in the Easy-link system.

In an Easy-link system of T-D2-IN or T-D2-OS, a maximum of four units of the T-D2-IN or T-D2-OS's can be linked together.

4. Press the "**INFO**" button to select the desired unit #.
5. When the desired unit # is selected and fixed, scroll up or down to the needed information (mode #) of the unit by pressing the "**HOT**" or "**COLD**" buttons.
   (Fig.3 shows mode #6 is being selected.) **When selecting information, please refer to the table on p.48 for the proper mode #.**
6. Press the "**INFO**" button to select the mode #, and information to which the mode # correlates to will display on the TM-RE30. (Fig. 4)
7. When the "**ON/OFF**" button is pressed or 5 minutes have elapsed without pressing any buttons, the display will return to normal.

Whole diagnostic mode

Fig.1

Unit #

Fig.2

Mode#

Fig.3

Information

Fig.4

For example, the figures above show how to arrive at the ON/OFF cycles information for Unit #2 in a Easy-Link System.

Description of mode numbers in “Diagnostics Mode”

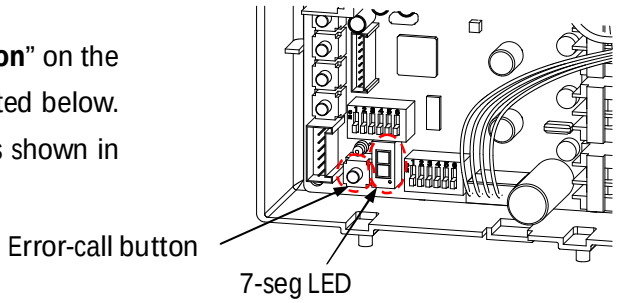
Mode #	Whole multi-unit system information (#0)		Unit information (#1 to #4)	
1	Total system flow rate	0 to 999 (×0.1 GPM)	Total operation time	0 to 9999 (hours)
2	N/A		ON/OFF cycles	0 to 9999 (×100 cycles)
3	Quantity of connected T-D2-IN or T-D2-OS’s	1 to 4 (units)	Fan motor speed	0 to 9999 (rpm)
4	Priority T-D2-IN or T-D2-OS unit	1 to 4 (unit #)	Inlet temperature	32 to 210 (°F). Over 210°F=E5, Under 32°F=E0
5	Quantity of operational T-D2-IN or T-D2-OS’s	1 to 4 (units)	Output temperature	
6	Set temperature	99 to 185 °F	Mixing temperature	
7	Operation time during current rotation	0 to 720 (minutes). After 720, the next rotation occurs	Air-Fuel ratio rod current	0 to 999 (×0.1μA)
8	ON/OFF cycles during current rotation	0 to 100 (cycles). After 100, the next rotation occurs	Flow rate	0 to 999 (×0.1 GPM)
9	N / A		Energization time of unit	0 to 9999 (×10 hour)
10**			Integrating flow of Unit	0 to 9999 (×1,000 gallon)
11**			Error code history: displays most recent error code	
12**			Error code history: displays 2nd most recent error code	
13**			Error code history: displays 3rd most recent error code	
14**			Clears memory in error code history*	
15**			N / A	
16**			Air-Fuel ratio stage	0 to 16, normal condition=6

* **TM-RE30:** Simultaneously press the “**INFORMATION**” button and the “**BUZZER**” buttons on the TM-RE30 while in mode# 14 for at least 5 seconds to completely clear the memory in the error code history.

** Mode #’s after #9 will be displayed as a number (e.g. “10”, “11”,....., “16”) on the TM-RE30. After #16, the TM-RE30 will cycle back to #1 again.

12-2. Verifying functionality of computer board and Displaying error code history, and Clearing error code history memory

The T-D2-IN and T-D2-OS has an "**Error-call button**" on the computer board that provides the functions listed below. The button is located next to the 7-seg LED (as shown in the picture to the right).

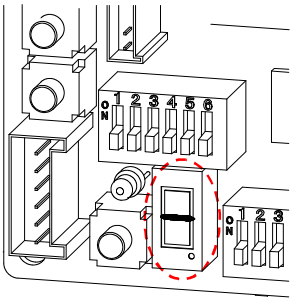


Check if the computer board works properly

1. Turn on the ON/OFF button of TM-RE30 remote control.
2. If the computer board works properly, the 7-seg LED will light in a circular "0" pattern, one segment at a time.

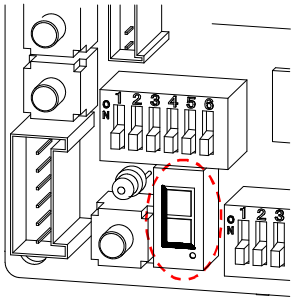
Displaying error code history

1. Briefly press the "**Error-call button**" (do not hold down the button).
2. If the T-D2-IN or T-D2-OS has had prior error codes, the 7-seg LED will display the most recent error code first. Pressing the button again will display the 2nd most recent error code and so on (Computer saves a maximum of 10 error codes). If the T-D2-IN or T-D2-OS has never had any error codes, the 7-seg LED will display a bar "—".



Clearing error code history memory

1. Press and hold the "**Error-call button**" for at least 5 seconds.
2. The 7-seg LED will display "C", "L" and "r" in succession to signify that the computer board memory has been erased of all error codes.



12-3. Clearing the "101" and "991" error code

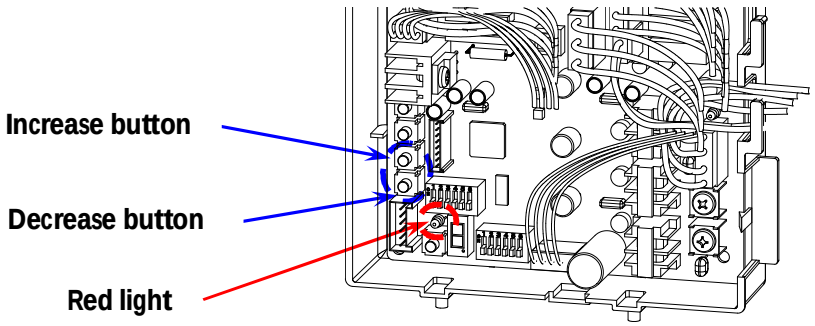
The "101" and "991" error codes signify imperfect (abnormal) combustion, caused by insufficient intake air and/or obstructions in the exhaust.

A. If the "101" and "991" error code occurs, please check the following:

1. What is the gas-type of the water heater: liquid propane or natural gas?
2. How long has the water heater been installed and been in use?
3. Where is the water heater installed: indoor, outdoor, attic, etc?
4. What is the altitude/elevation of the area of installation?
5. Are there any obstructions in the intake air and/or exhaust?
   - Damper sticking.
   - Vent Flaps installed on the Terminator.
   - Snow build up around Terminator.
   - Installed in a closet. (No Ventilation or lack of combustion air)
6. If installed in laundry room, check the burner and heat exchanger. Dust and lint may deposit in burner and heat exchanger.
7. If installed in restaurant, check the burner and fan motor. Grease and dirt may deposit in burner and fan motor.
8. Check if the manifold pressure of the water heater is too high.

B. How to clear the "101" and "991" error code (after resolving the main root cause of the error):

On the computer board, press and hold the "**Increase**" and "**Decrease**" buttons simultaneously for at least 3 seconds until the red light turns on. Turn off the 120 VAC by Power ON-OFF switch and turn back on. The "101" and "991" error code should then be cleared.



12-4. AFR rod function

<Function>
The AFR rod checks flame conditions during combustion. When the AFR rod detects unexpected flame conditions, the computer board of the T-D2 adjusts the fan motor speed to ensure that air and fuel are always at a proper mixture ratio, minimizing emissions.

<AFR normal range of values> (Unit: μA)

Model		T-D2-IN		T-D2-OS	
Gas type		LPG	Natural gas	LPG	Natural gas
Combustion mode	MAX	8.8 to 32.5	12.5 to 35.0	2.5 to 50.0	9.0 to 38.0
	MIN	1.5 to 13.2	2.0 to 11.5	3.5 to 18.5	2.0 to 10.5

- If the detected AFR value is higher than the normal value, the FM speed is increased.
- If the AFR value is lower than the normal value, the FM speed is decreased.
- **These values are read with the front cover close.**
- Measure the values after burning the water heater for ten minutes.

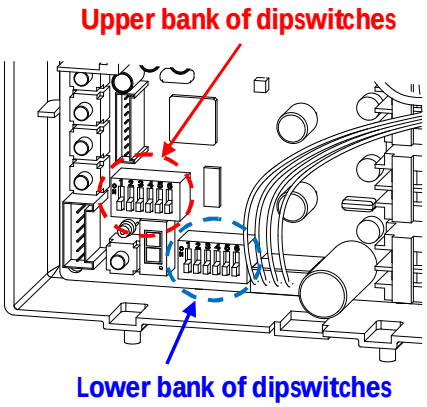
*The AFR stage can be confirmed in "Diagnostic Mode". (Section 12-1)

<The relationship between the AFR stage and the "10" and "99" error codes>

FM	Stage	
+15%	16	"991" error code
+13.5%	15	"101" error code
	⋮	
0%	6	Default condition
	⋮	
-9%	0	

(Condition of AFR stage)
- 0 to 5: Air-rich
- In order to solve the "air excess" problem, the fan motor speed is automatically decreased and AFR combustion stage goes down.
- 6: Default
- 7 to 16: Gas-rich or Air shortage
- In order to solve the "air deficiency" problem, the fan motor speed is automatically increased and AFR combustion stage goes up.
- 15: "101" error code
- 16: "991" error code
- When the "101" or "991" error code appears, see section 12-3.

12-5. Dipswitch settings



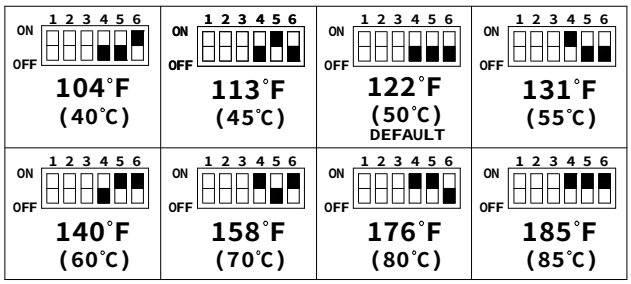
The T-D2-IN shares the computer board with the T-D2-OS. The computer board has two bank of dipswitches: “upper” and “lower”. The upper bank has certain special functions as shown on the following table and generally should not need adjustment. Carefully verify the functions of each dipswitch before changing any settings.

The functions of the upper bank of dipswitches

<table>
<tr><td>No.</td><td>Functions</td><td>ON position</td><td>OFF position</td></tr>
<tr><td>1</td><td rowspan="2">Gas type</td><td>Propane</td><td>Disable</td></tr>
<tr><td>2</td><td>Natural gas</td><td>Disable</td></tr>
<tr><td>3</td><td>Allow adjustments of fan motor speed
(Changing the FM speed is similar to changing the manifold pressure. See section 12-13)</td><td>Enable</td><td>Disable
(Default)</td></tr>
<tr><td>4
5</td><td colspan="3">FM+, FM++ and FM+++
(FM speed is increased automatically. See section 12-10)

T-D2-IN
<table><tr><td colspan="2" rowspan="2"></td><td colspan="2">No. 4</td></tr><tr><td>OFF position</td><td>ON position</td></tr><tr><td rowspan="2">No. 5</td><td>OFF position</td><td>0 %</td><td>+6 %</td></tr><tr><td>ON position</td><td>+12 %</td><td>+18 %</td></tr></table>
T-D2-OS
<table><tr><td colspan="2" rowspan="2"></td><td colspan="2">No. 5</td></tr><tr><td>OFF position</td><td>ON position</td></tr><tr><td rowspan="2">No. 6</td><td>OFF position</td><td>0 %</td><td>+4 %</td></tr><tr><td>ON position</td><td>+8 %</td><td>+12 %</td></tr></table></td></tr>
<tr><td>6</td><td>N/A</td><td>N/A</td><td>N/A
(Default)</td></tr>
</table>

The function of the lower bank of dipswitches

No.	Functions	ON position	OFF position
1	Parent / Child setting for Easy-Link systems	Parent	Child (Default)
2	Model type	(Default) T-D2-IN	Disable
3		(Default) T-D2-OS	Disable
4 5 6	Output temperature settings (See table to the right) (Default 122°F)		

12-6. Assigning unit numbers in the Easy-link system

A. How to display the unit number

Press the "**Increase**" button on the computer board. The 7-seg LED will then display the assigned number for that T-D2-IN or T-D2-OS unit for 10 sec.

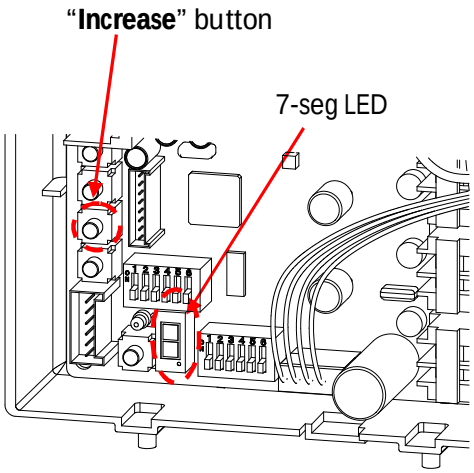
NOTE: In a single-unit installation, the numbering system is disabled.

B. How to reset and reconfigure the numbering of units

Unit #'s can be reset and reassigned manually:

1. Press and hold the "**Increase**" button on the computer board of all child units for at least 5 seconds.
2. The 7-seg LED on the computer board of all child units will display "0" to signify that the computer memory has been erased of its previously assigned unit #.
3. **Press and hold the "Increase" button on each unit in the new order of your choosing. The new unit numbers will be assigned in this order.**

- Each T-D2-IN or T-D2-OS in an Easy-link system is assigned a random unit #, except for the Parent unit, which is always assigned as unit #1.
- When more than four units of the T-D2-IN or T-D2-OS are connected in an Easy-link system, only the first four units will work as a system. The remaining units will not operate.



Computer board

12-7. (A) ON/OFF conditions: Overview

The following table shows the ON/OFF conditions of the water heater.

ON/OFF Conditions	
Conditions needed to turn ON.	The BTU requirement is more than 14,880 BTU/h AND The water flow rate is more than 0.75 GPM
Conditions needed to turn OFF.	The BTU requirement is less than 11,900 BTU/h OR Inlet temperature is higher than the set temperature OR Output temperature is over 194°F OR The water flow rate is less than 0.4 GPM

12-7.(B) ON/OFF conditions: BTU requirements

A. Calculating the ON/OFF conditions of the T-D2-IN or T-D2-OS

【Condition needed to turn the T-D2-IN or T-D2-OS ON】

$(T_{set} - T_{in}) \times GPM \times 500 > 14{,}880$

【Condition needed to turn the T-D2-IN or T-D2-OS OFF】

$(T_{set} - T_{in}) \times GPM \times 500 < 11{,}900$ or $T_{in} = T_{set}$

Where: T_{set} = Set temperature and T_{in} = Inlet temperature

B. Calculation example

Set temperature: $T_{set} = 122°F$ Flow rate = 2.5 GPM

【Condition needed to turn the T-D2-IN or T-D2-OS ON】

$(122 - T_{in}) \times 2.5 \times 500 > 14{,}880$ $T_{in} < 110.1°F$

【Condition needed to turn the T-D2-IN or T-D2-OS OFF】

$(122 - T_{in}) \times 2.5 \times 500 < 11{,}900$ $T_{in} > 112.5°F$

The output temperature at that moment will be 120°F

C. ON/OFF table

Set temperature (°F)		Flow rate (GPM)							
		0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0
113	ON	53.5	83.2	93.2	98.1	101.1	103.1	104.5	105.6
	OFF	65.4	89.2	97.1	101.1	103.5	105.1	106.2	107.0
122	ON	62.5	92.2	102.2	107.1	110.1	112.1	113.5	114.6
	OFF	74.4	98.2	106.1	110.1	112.5	114.1	115.2	116.0
131	ON	71.5	101.2	111.2	116.1	119.1	121.1	122.5	123.6
	OFF	83.4	107.2	115.1	119.1	121.5	123.1	124.2	125.0
140	ON	80.5	110.2	120.2	125.1	128.1	130.1	131.5	132.6
	OFF	92.4	116.2	124.1	128.1	130.5	132.1	133.2	134.0
158	ON	98.5	128.2	138.2	143.1	146.1	148.1	149.5	150.6
	OFF	110.4	134.2	142.1	146.1	148.5	150.1	151.2	152.0
167	ON	107.5	137.2	147.2	152.1	155.1	157.1	158.5	159.6
	OFF	119.4	143.2	151.1	155.1	157.5	159.1	160.2	161.0
185	ON	125.5	155.2	165.2	170.1	173.1	175.1	176.5	177.6
	OFF	137.4	161.2	169.1	173.1	175.5	177.1	178.2	179.0

12-8. (A) Pump control ON/OFF Conditions (Only for single and Easy-link system)

To run circulation pumps efficiently and effectively, the T-D2-IN / T-D2-OS offers mode of pump control. The following table shows the pump control ON/OFF conditions.

"Re-circulation mode"

These functions enable the re-circulation pump to be controlled by the following conditions.

ON/OFF Conditions	Re-circulation mode
Conditions that activate the pump	The BTU requirement is more than 18,600 BTU/h* OR 30 minutes have elapsed after previous operation
Conditions that deactivate the pump	4 minutes after activation, if the computer detects a BTU requirement of less than 14,800 BTU/h, the computer will stop the pump in 90 seconds.

*The computer records the inlet temperature and the flow rate of the pump during the final minute of its previous operation when calculating the BTU requirement.

12-8. (B) Pump control ON/OFF conditions: BTU requirements

A. Calculating the ON/OFF conditions of the pump

【Condition needed to turn the pump ON】

$(T_{set} - T_{in}) \times GPM \times 500 > 18,600$

【Condition needed to turn the pump OFF】

4 minutes after activation, if the computer detects a BTU requirement of less than 18,600 BTU/h, the computer will stop the pump 90 seconds.

$(T_{set} - T_{in}) \times GPM \times 500 < 14,800$ or $T_{in} = T_{set}$

Where: T_{set} = Set temperature and T_{in} = Inlet temperature

B. Calculation example

Set temperature: T_{set} = 122 ˚F Flow rate = 2.5 GPM

【Condition needed to turn the pump ON】

$(122 - T_{in}) \times 2.5 \times 500 > 18,600$ $T_{in} < 107.1$˚F

【Condition needed to turn the pump OFF】

$(122 - T_{in}) \times 2.5 \times 500 < 14,800$ $T_{in} > 107.1$˚F

C. ON/OFF table

Set temperature (˚F)		Flow rate (GPM)							
		0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0
113	ON	38.6	75.8	88.2	94.4	98.1	100.6	102.4	103.7
	OFF	53.8	83.4	93.3	98.2	101.2	103.1	104.5	105.6
122	ON	47.6	84.8	97.2	103.4	107.1	109.6	111.4	112.7
	OFF	62.8	92.4	102.3	107.2	110.2	112.1	113.5	114.6
131	ON	56.6	93.8	106.2	112.4	116.1	118.6	120.4	121.7
	OFF	71.8	101.4	111.3	116.2	119.2	121.1	122.5	123.6
140	ON	65.6	102.8	115.2	121.4	125.1	127.6	129.4	130.7
	OFF	80.8	110.4	120.3	125.2	128.2	130.1	131.5	132.6
158	ON	83.6	120.8	133.2	139.4	143.1	145.6	147.4	148.7
	OFF	98.8	128.4	138.3	143.2	146.2	148.1	149.5	150.6
167	ON	92.6	129.8	142.2	148.4	152.1	154.6	156.4	157.7
	OFF	107.8	137.4	147.3	152.2	155.2	157.1	158.5	159.6
185	ON	110.6	147.8	160.2	166.4	170.1	172.6	174.4	175.7
	OFF	125.8	155.4	165.3	170.2	173.2	175.1	176.5	177.6

12-9. Multi-unit system ON/OFF conditions

In an Easy-Link system, the amount of T-D2-IN or T-D2-OS called on to activate depends on the **FLOW RATE** and the **SET TEMPERATURE**.

1. Condition required to activate an additional T-D2-IN or T-D2-OS:

Flow rate required to activate additional T-D2-IN or T-D2-OS= A × n

Where **n** = number of currently activated T-D2-IN or T-D2-OS

and **A** is dependent on the set temperature. See table below:

Set temperature		**Factor "A"**	
˚F	˚C	GPM	L/min
100 - 122	37 - 50	3.4	13
131	55	3.2	12
140	60	2.9	11
149	65	2.6	10
158 - 167	70 - 75	2.4	9
176 - 185	80 - 85	2.1	8

2. Condition required to reduce the number of activated T-D2-IN or T-D2-OS:

A. **In the case of reducing down from two units of T-D2-IN or T-D2-OS to one unit of T-D2-IN or T-D2-OS: Flow rate = A / 1.7**

B. **All other cases: Flow rate = A × (n - 2)**

3. Example: Set temperature = 122˚F in a four unit system and priority unit is No. 1

To activate additional T-D2-IN or T-D2-OS

Unit No.	Flow rate	
	GPM	L/min
No.1 ON	0.75	3.0
No.2 ON	3.4	13
No.3 ON	6.8	26
No.4 ON	10.2	39

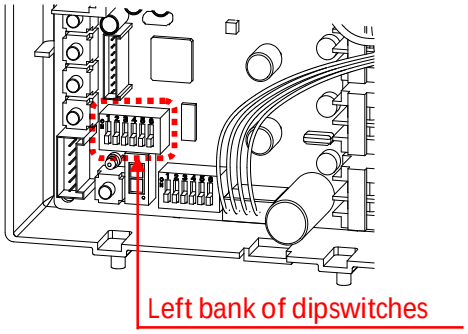
To reduce number of activated T-D2-IN or T-D2-OS

Unit No.	Flow rate	
	GPM	L/min
No.4 OFF	6.8	26
No.3 OFF	3.4	13
No.2 OFF	2.0	7.6
No.1 OFF	0.37	1.5

12-10. High-Altitude Region Support Functions (FM+, FM++ and FM+++)

<Using these functions>

The high-altitude region support functions have four operation levels, with the appropriate level being set up by the installer until the abnormal sound problem is solved. The desired level can be specified at the left bank of dipswitches (No.4 and No.5) on the computer board. See the table in the next page.



Level	Elevation	Function	Setting Method
0	0 to 2,000 ft (DEFAULT)	Standard setting (Default)	Left bank of dipswitches No.4 OFF No.5 OFF
1	2,000 to 4,000ft	**FM+ function** ・the fan motor speed increased by 6% (T-D2-IN) ・the fan motor speed increased by 4% (T-D2-OS)	Left bank of dipswitches **No.4 ON** No.5 OFF
2	4,000 to 6,000ft	**FM++ function** ・the fan motor speed increased by 12% (T-D2-IN) ・the fan motor speed increased by 8% (T-D2-OS)	Left bank of dipswitches No.4 OFF **No.5 ON**
3	Over 6,000ft	**FM+++ function*** ・the fan motor speed increased by 18% (T-D2-IN) ・the fan motor speed increased by 12% (T-D2-OS)	Left bank of dipswitches **No.4 ON** **No.5 ON**
4	Consult our Technical Services Department. If the abnormal sound problem persists even with a “Level 3” setting, please contact our Technical Service Department. for advice. Note that there are many high risks associated with manually changing the manifold pressures.		

*T-D2-IN/OS installation manual doesn’t mention this function for safety purposes.

12-11. Relay selection for the pump control connection

The maximum current capacity of pump control connection in the T-D2 is 1 amp.
Before using any relay with the pump control, please check the specifications of that particular relay to ensure that the current value through the coil will not exceed 1 amp.

For example:
To the right, there is a sample of relay specifications from an arbitrary brochure. You can select either the 120 VAC or 240 VAC relay, because their current values are less than 1A (1,000mA).

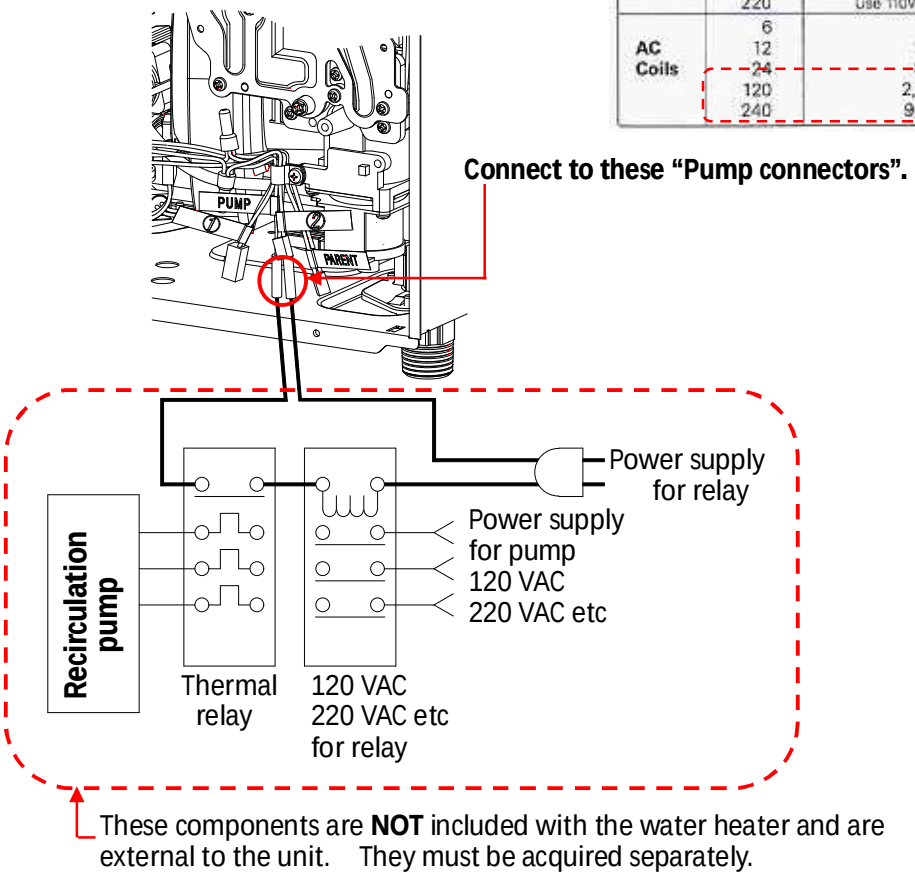
Coil Data @ 25°C

		Nominal Power	Maximum Power
KRP	AC	2VA	Enclosed Models - 4VA
KRPA	DC	1.2W	Enclosed Models - 3W
KA	AC	2VA	Open Models - 4VA
	DC	125mW per movable arm	Open Models - 4W

Duty Cycle: Continuous.
Initial Insulation Resistance: KRP, KRPA - 1000 Megohms, min.
KA - 100 Megohms, min.

Coil Data @ 25°C

	Nominal Voltage	DC Resistance (Ω) ±10%	Nominal Coil Current (mA)
DC Coils	6	32	188
	12	120	100
	24	472	51
	48	1,800	26.6
	110	10,000	11.5
	220	Use 110V relay with 10,000 Ω 5W Resistor in series	
AC Coils	6	6	335
	12	24	168
	24	85	84
	120	2,250	17.5
	240	9,110	8.75



12-12. Adjusting manifold gas pressure

The manifold gas pressure on the T-D2-IN or T-D2-OS can be adjusted by following the procedures.

WARNING

Adjusting the manifold pressure can cause unexpected combustion conditions during operation, which can cause a health hazard, damage the T-D2-IN or T-D2-OS, and/or shorten its lifespan. Therefore, changing the manifold pressure is not recommended unless there are very strong reasons to do so (e.g. high elevation installations), and with the consultation of the Technical Services Department.

Adjusting maximum manifold pressure

1. Ensure that T-D2-IN or T-D2-OS is not in operation.
2. Remove the screw off the manifold port of the T-D2-IN or T-D2-OS. (Figure 1)
3. Connect a manometer to the manifold port using a tube (Figure 2). Ensure that this connection is secure enough to prevent gas leak.
4. Run water through the T-D2-IN or T-D2-OS to activate its operation. If presence of a gas leak is detected, immediately shut off the T-D2-IN or T-D2-OS and inspect the tube/manifold connection; otherwise, proceed onto the next step.
5. Press and hold down the **"MAX"** button on the computer board. While holding down the "MAX" button, press either the **"Increase"** or **"Decrease"** button to increase or decrease the manifold gas pressure, respectively (Figure 3). Refer to the manometer to verify that pressure has been set to desired value.
6. After gas pressure has been set, deactivate the T-D2-IN or T-D2-OS, remove the manometer tube, and replace the port screw.

Adjusting minimum manifold pressure

1. Ensure that T-D2-IN or T-D2-OS is not in operation.
2. Remove the screw off the manifold port of the T-D2-IN or T-D2-OS. (Figure 1)
3. Connect a manometer to the manifold port using a tube (Figure 2). Ensure that this connection is secure enough to prevent gas leak.
4. Run water through the T-D2-IN or T-D2-OS to activate its operation. If presence of a gas leak is detected, immediately shut off the T-D2-IN or T-D2-OS and inspect the tube/manifold connection; otherwise, proceed onto the next step.
5. Press and hold down the **"MIN"** button on the computer board. While holding down the "MIN" button, press either the **"Increase"** or **"Decrease"** button to increase or decrease the manifold gas pressure, respectively (Figure 3). Refer to the manometer to verify that pressure has been set to desired value.

6. After gas pressure has been set, deactivate the T-D2-IN or T-D2-OS, remove the manometer tube, and replace the port screw.

Figure 1

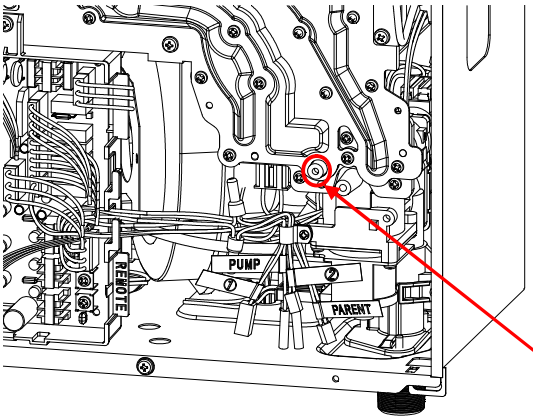


Figure 2

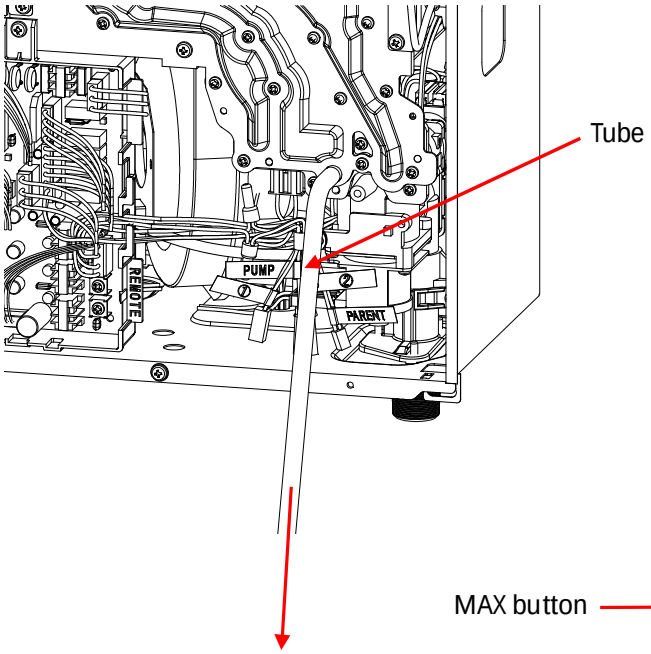
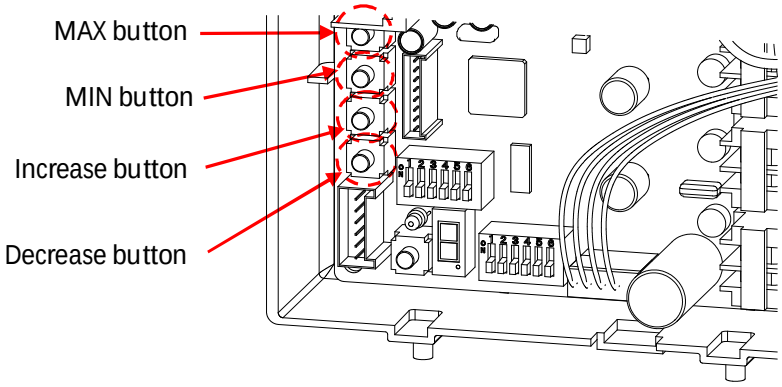


Figure 3



12-13. Manually adjusting the fan motor speed

While the FM+ dipswitch will automatically increase the fan speed, the fan motor speed on the T-D2-IN or T-D2-OS can also be manually adjusted. In order to perform manual adjustments to the speed, a TM-RE30 remote controller is required.

WARNING

Manually adjusting the fan motor speed of the T-D2-IN or T-D2-OS will change the amount of intake air for combustion, which can cause excess CO emission from the exhaust chamber if the fan motor speed is set incorrectly. Therefore, this procedure should **never** be performed unless the Technical Services Department has given consent and authorization.

Adjusting maximum fan motor speed

1. While T-D2-IN or T-D2-OS is in operation, set dipswitch No.3 to the "ON" position. (Figure 1)
2. On the temperature remote controller, display mode #3 (fan motor speed) by entering the "Diagnostics mode" (Refer to Section 12-1).
3. Press and hold down the **"MAX"** button on the computer board. While holding down the "MAX" button, press either the **"Increase"** or **"Decrease"** button to increase or decrease the fan motor speed, respectively (Figure 2). Refer to the remote controller display to verify that speed has been set to desired value.
4. After fan speed has been set, set dipswitch No.3 back to the "OFF" position.

Adjusting minimum fan motor speed

1. While T-D2-IN or T-D2-OS is in operation, set dipswitch No.3 to the "ON" position. (Figure 1)
2. On the temperature remote controller, display mode #3 (fan motor speed) by entering the "Diagnostics mode" (Refer to Section 12-1).
3. Press and hold down the **"MIN"** button on the computer board. While holding down the "MIN" button, press either the **"Increase"** or **"Decrease"** button to increase or decrease the fan motor speed, respectively (Figure 2). Refer to the remote controller display to verify that speed has been set to desired value.
4. After fan speed has been set, set dipswitch No.3 back to the "OFF" position.

Upper bank of dipswitch settings

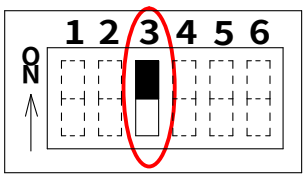
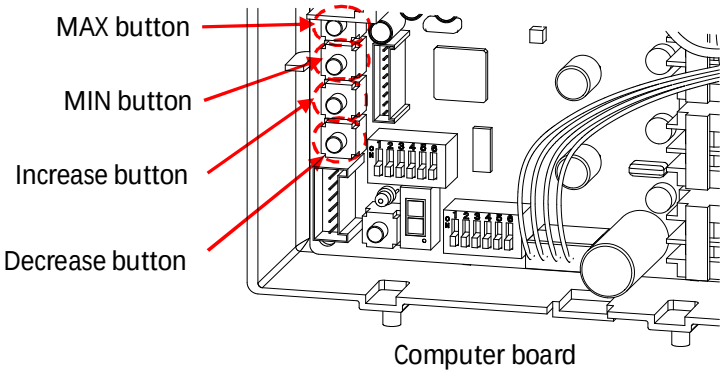


Figure 1

The dark square is the direction the dipswitch should be set to.

Figure 2



12-14. Freeze protection system

There are two features to the T-D2-IN or T-D2-OS's freeze protection system: the automatic firing system and the ceramic heating blocks. The automatic firing system allows the T-D2-IN or T-D2-OS to briefly fire on for about 4 seconds and the ceramic heating blocks will heat up whatever portion of the heat exchanger the blocks are strapped to. The firing system mainly focuses on providing freeze protection around the heat exchanger pipes. The three heating blocks focus on protecting the inlet and outlet piping inside the T-D2-IN or T-D2-OS, as well as the front drum pipe. The conditions to activate either feature are different from each other. However, the two features are not mutually exclusive, because they focus on different areas of the T-D2-IN or T-D2-OS. As long as each particular feature's activation requirements are met, it is possible for both features to operate at the same time.

Automatic firing system

Activation conditions will depend on the on whether or it is an indoor / direct-vent or outdoor installation. Gas and electrical power are required for this feature to operate.

T-D2-IN installation:

After 5 minutes have elapsed since the T-D2-IN or T-D2-OS's previous firing operation, the computer will continually check the temperatures of the inlet and output thermistors (the output thermistor is the one that checks the temperature of the water immediately leaving the heat exchanger, not the water leaving the T-D2-IN or T-D2-OS, which is mixed with water from the bypass valve). The automatic firing system will not activate at all unless these 5 minutes have elapsed.

When the computer checks for these temperatures, the freeze protection firing system will activate if:

$T_{in} \leqq 37°F$ and $T_{out} \leqq 50°F$ **OR** $T_{out} \leqq 37°F$

where T_{in} is the temperature of inlet thermistor and T_{out} is the temperature of the output thermistor.

To sum it up in a chart:

Case	5 minutes have elapsed since prior operation?	Inlet thermistor temperature	Output thermistor temperature	Will automatic firing be activated?
1	No	Any	Any	NO
2	Yes	Above 37°F	Any	NO
3	Yes	Any	Above 50°F	NO
4	Yes	37°F and below	50°F and below	YES
5	Yes	Any	37°F and below	YES

T-D2-OS installation:

After 25 minutes have elapsed since the T-D2-IN or T-D2-OS's previous firing operation, the computer will continually check the temperatures of the inlet and output thermistors. The automatic firing system will not activate at all unless these 25 minutes have elapsed.

When the computer checks for these temperatures, the freeze protection firing system will activate if:

$T_{in} \leqq 37°F$ and $T_{out} \leqq 50°F$ **OR** $T_{out} \leqq 37°F$

where T_{in} is the temperature of inlet thermistor and T_{out} is the temperature of the output thermistor.

To sum it up in a chart:

Case	25 minutes have elapsed since prior operation?	Inlet thermistor temperature	Output thermistor temperature	Will automatic firing be activated?
1	No	Any	Any	NO
2	Yes	Above 37°F	Any	NO
3	Yes	Any	Above 50°F	NO
4	Yes	37°F and below	50°F and below	YES
5	Yes	Any	37°F and below	YES

Ceramic heating blocks

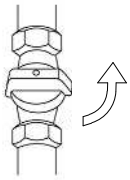
The blocks will only activate based on what the freeze protection thermostat senses. The thermostat is located on the fan motor, close in vicinity to the inlet and outlet pipes within the T-D2-IN or T-D2-OS. Electrical power is required for this feature to operate.

The heating blocks will activate if the thermostat senses a surrounding temperature **below 36.5°F.**

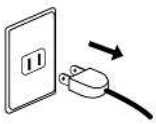
Once they are on, the heating blocks will only deactivate if surrounding temperatures reach **above 46.4°F.**

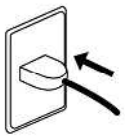
12-15. Draining and cleaning the inlet water filter

1. Close the manual gas shut off valve.

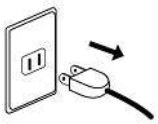


2. Turn off power to the T-D2-IN or T-D2-OS, wait a few seconds. And then turn on again.

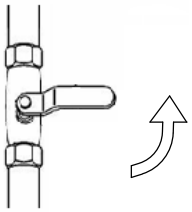




3. Wait 30 seconds for water valves starts to completely open.
Then turn off power to the T-D2-IN or T-D2-OS, yet again.

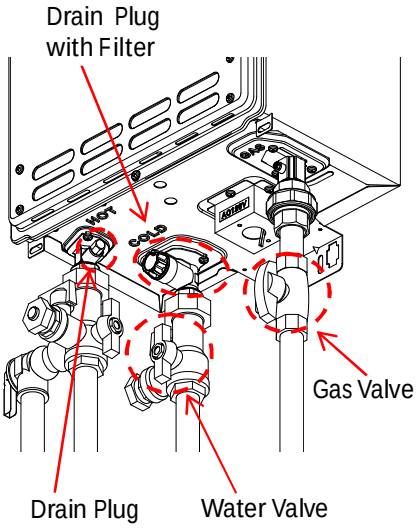


4. Close the water shut-off valve.



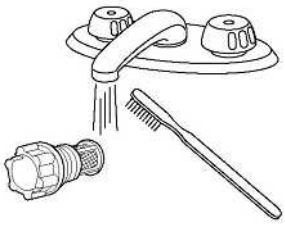
5. Open all hot water taps in the house. When the all water flow has ceased, close all hot water taps.

6. Have a bucket or pan to catch the water from the drain plugs of the T-D2-IN or T-D2-OS. **<u>Unscrew</u>** the drain plugs to drain all the water out of the T-D2-IN or T-D2-OS.



7. Wait a few minutes to ensure all water has completely drained from unit.

8. Clean the filter: Inspect the water filter located within the cold inlet. With a tiny brush, clean the water filter of any debris which may have accumulated and reinsert the filter back into the cold water inlet.

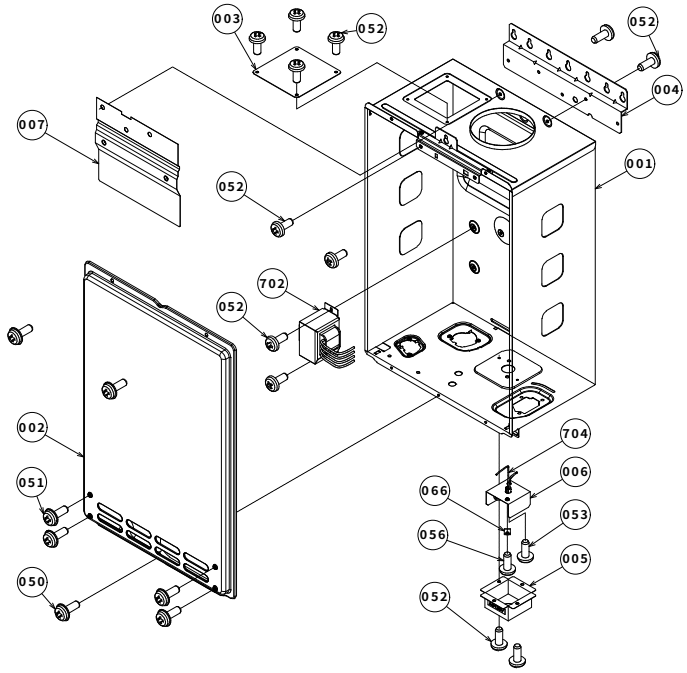


9. Securely screw the drain plugs back into place. **<u>Hand-tighten only.</u>**

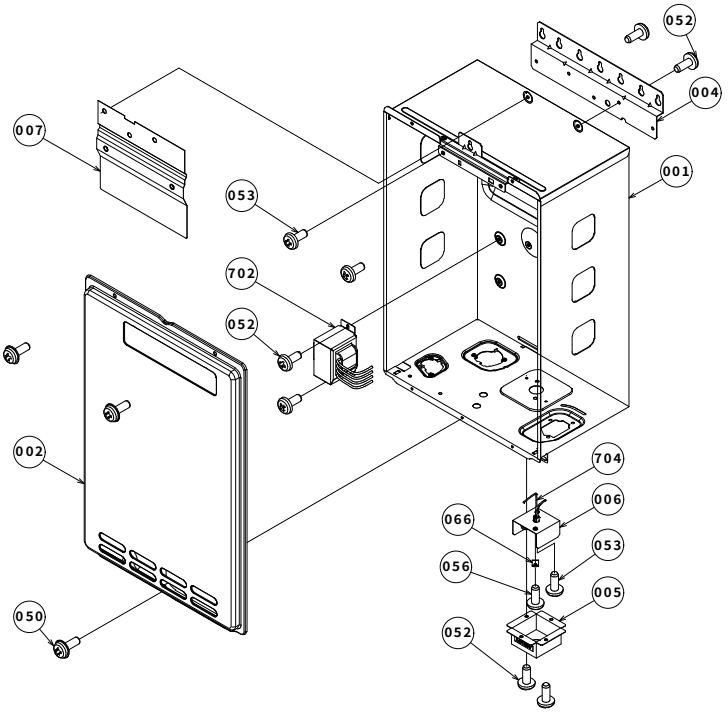
13. Components diagrams

Case assembly

T-D2-IN

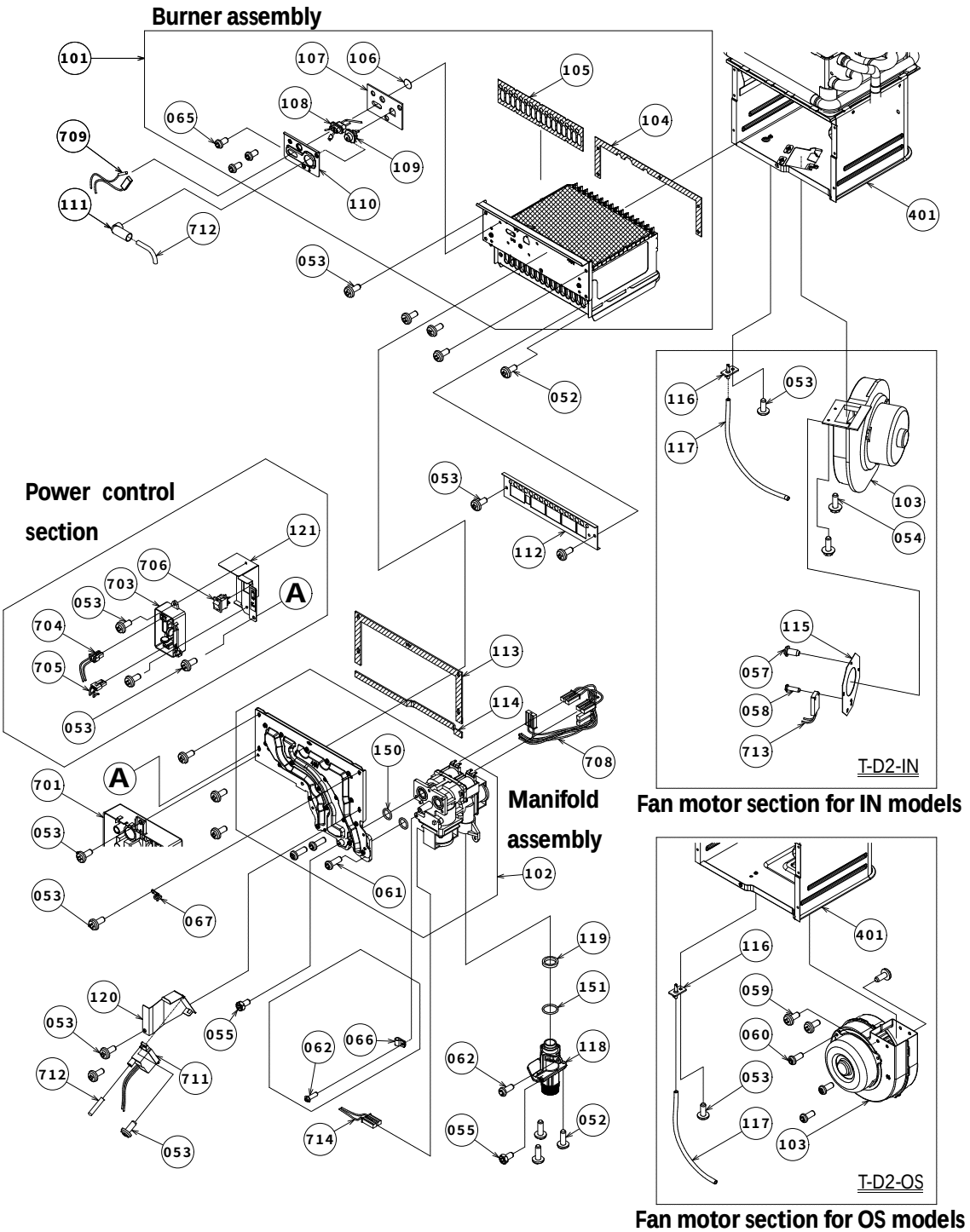


T-D2-OS



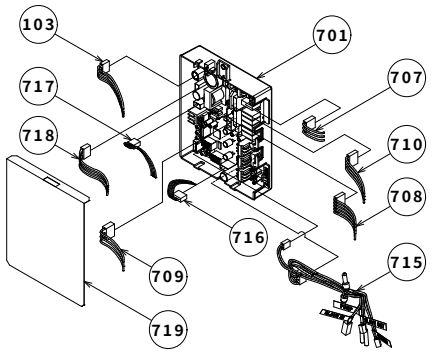
Burner assembly

T-D2-IN/OS



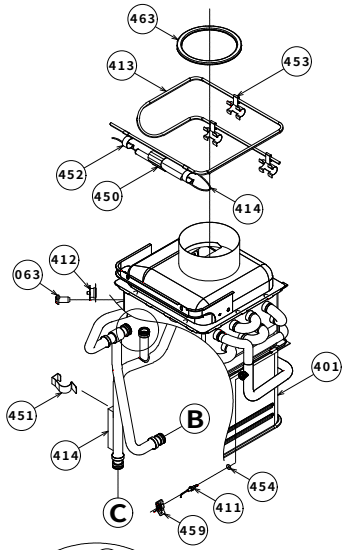
Computer board assembly

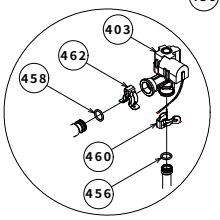
T-D2-IN/OS



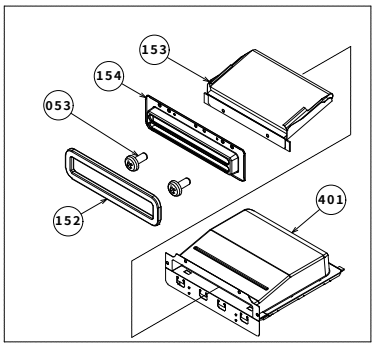
Water way assembly

T-D2-IN/OS

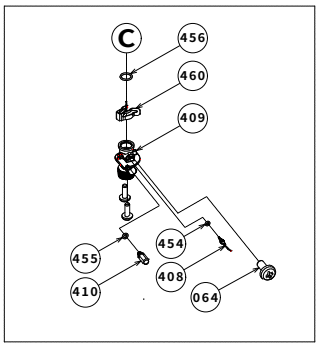




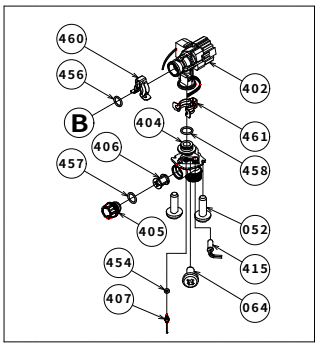
Bypass section



Exhaust section (OS model)



Water outlet section



Water inlet section

14. Parts list

Item #	Part #	Description	Common parts for other models
001	EK402	Case assembly (IN)	T-K4-IN
	EKK41	Case assembly (OS)	T-K3-OS, T-K4-OS
002	EK434	Front cover (IN)	
	EK435	Front cover (OS)	
003	EK401	Air blockage plate	T-KJr2-IN/OS, T-K4-IN/OS
004	EKJ09	Bracket	T-K3, T-K3-Pro, T-K3-SP/OS,T-KJr2-IN/OS, T-K4-IN/OS
005	EKJ64	Junction box	T-K3, T-K3-Pro, T-K3-SP/OS, T-H2-DV/OS , T-KJr2-IN/OS, T-K4-IN/OS, T-M50, T-M32
006	EKJ66	Junction box inner plate	T-K3, T-K3-Pro, T-K3-SP/OS, T-H2-DV/OS T-KJr2-IN/OS, T-K4-IN/OS
007	EKK5H	Back guard panel	T-K3, T-K3-Pro, T-K3-SP/OS, T-K4-IN/OS
050	EW000	Screw M4×12 (W/Washer)	*
051	EW001	Screw M4×10 (w/washer)	*
052	EW002	Screw M4×10 (Coated)	*
053	EW003	Screw M4x10	*
054	EW004	Hex head screw M4×12 (W/Washer)	*
055	EW005	Hex head screw M4x8	*
056	EX014	Screw M4x10	*
057	EW00B	Screw M3x6 SUS3	*
058	EW008	Screw M3x10	*
059	EW00H	Pan screw M4x12 (W/Washer)	*
060	EW024	Pan screw M4x10 FEZN	*
061	EKK31	Tap tight screw M4x12 FEZN	*
062	EW006	Pan screw M4x10	*
063	EW00A	Screw M3x6	*
064	EW009	Screw M4x6	*
065	EW00D	Pan screw M4x8	*
066	EC00X	Nylon clamp	T-K3, T-K3-Pro, T-K3-SP/OS, T-H2-DV/OS, T-KJr2-IN/OS, T-K4-IN/OS, T-M32

Item #	Part #	Description	Common parts for other models
067	EM167	Wire clamp 60	T-K3, T-K3-Pro, T-K3-SP/OS, T-H2-DV/OS, T-KJr2-IN/OS, T-K4-IN/OS, T-M50, T-M32
101	EKH5W	Burner assembly	T-H2-DV/OS, T-K4-IN/OS
102	EKH6T	Manifold with gas valve assembly LP	T-H2-DV/OS, T-K4-IN/OS
	EKK5K	Manifold with gas valve assembly NA	T-K4-IN/OS
103	EKK25	Fan motor (IN)	T-K3, T-K3-Pro, T-K3-SP, T-H2-DV/OS, T-K4-IN, T-M50, T-M32
	EKK54	Fan motor (Out)	T-K3-OS, T-K4-OS
104	EKK0G	Burner holder gasket	T-K3, T-K3-Pro, T-K3-SP/OS, T-H2-DV/OS, T-K4-IN/OS, T-M50
105	EKK2X	Burner gasket	T-K3, T-K3-Pro, T-K3-SP/OS, T-H2-DV/OS, T-KJr2-IN/OS, T-K4-IN/OS
106	EKK2V	Burner window	T-K3, T-K3-Pro, T-K3-SP/OS, T-H2-DV/OS, T-KJr2-IN/OS, T-K4-IN/OS, T-M50, T-M32
107	EKK2W	Rod holder gasket	T-H2-DV/OS, T-KJr2-IN/OS, T-K4-IN/OS, T-M50, T-M32
108	EKK0E	Flame rod	T-K3, T-K3-Pro, T-K3-SP/OS, T-H2-DV/OS, T-K4-IN/OS, T-M50, T-M32
109	EKK0F	Igniter rod	T-K3, T-K3-Pro, T-K3-SP/OS, T-H2-DV/OS, T-K4-IN/OS, T-M50, T-M32
110	EKK32	Rod holder	T-K3, T-K3-Pro, T-K3-SP/OS, T-H2-DV/OS, T-K4-IN/OS, T-M50, T-M32
111	EKN61	Rod cap	T-K3, T-K3-Pro, T-K3-SP/OS, T-H2-DV/OS, T-KJr2-IN/OS, T-K4-IN/OS, T-M50, T-M32
112	EK412	Burner damper	T-K4-IN/OS
113	EKK2Y	Manifold gasket A	T-K3, T-K3-Pro, T-K3-SP/OS, T-H2-DV/OS, T-KJr2-IN/OS, T-K4-IN/OS, T-M50
114	EKK2K	Manifold gasket B	T-K3, T-K3-Pro, T-K3-SP/OS,T-H2-DV/OS, T-KJr2-IN/OS, T-K4-IN/OS, T-M50
115	TU001	Fan damper	T-K4-IN
116	EKK2D	Pressure port	T-K3, T-K3-Pro, T-K3-SP, T-H2-DV/OS, T-K4-IN/OS, T-M50, T-M32

Item #	Part #	Description	Common parts for other models
117	EKK2N	Combustion chamber tube (In)	T-K3, T-K3-Pro, T-K3-SP, T-H2-DV/OS, T-K4-IN
	EX019	Combustion chamber tube (Out)	T-K4-OS, T-M50
118	EKK1E	Gas inlet	T-K3, T-K3-Pro, T-K3-SP/OS, T-H2-DV/OS, T-KJr2-IN/OS, T-K4-IN/OS
119	EKK2Z	Gas inlet ring	T-K3, T-K3-Pro, T-K3-SP/OS,T-H2-DV/OS, T-KJr2-IN/OS, T-K4-IN/OS
120	EKK1B	Igniter plate	T-K3, T-K3-Pro, T-K3-SP/OS,T-H2-DV/OS, T-KJr2-IN/OS, T-K4-IN/OS, T-M50, T-M32
121	EK436	Surge box plate	
150	EZP18	O-ring P18 NBR (Black)	T-K3, T-K3-Pro, T-K3-SP/OS, T-KJr2-IN/OS, T-K4-IN/OS, T-M50
151	EK042	O-ring P20 NBR (Black)	T-K3, T-K3-Pro, T-K3-SP/OS, T-H2-DV/OS, T-KJr2-IN/OS, T-K4-IN/OS, T-M50
152	EKK3G	Silicon ring	T-K3-OS, T-K4-OS, T-M50
153	EKK53	Rain protection plate in Exhaust chamber	T-K3-SP/OS, T-KJr2-OS, T-K4-OS
154	EKK56	Exhaust port	T-K3-OS, T-KJr2-IN/OS
401	TU002	Heat exchanger assembly (IN)	
	EK437	Heat exchanger assembly (OS)	
402	EK438	Flow adjustment valve / Flow sensor	
403	EKK0U	Bypass valve	T-K3, T-K3-Pro
404	EKK1U	Water inlet	T-K3, T-K3-Pro, T-K3-SP/OS, T-KJr2-IN/OS, T-K4-IN/OS
405	EKK2B	Inlet drain plug	T-K3, T-K3-Pro, T-K3-SP/OS, T-KJr2-IN/OS, T-K4-IN/OS
406	EKK2C	Inlet water filter	T-K3, T-K3-Pro, T-K3-SP/OS, T-KJr2-IN/OS, T-K4-IN/OS
407	EKK38	Inlet thermistor	T-K3, T-K3-Pro, T-H2-DV/OS, T-M50, T-M32
408	EKK1A	Mixing thermistor	T-K3, T-K3-Pro, T-M50
409	EKK1V	Water outlet	T-K3, T-K3-Pro, T-K3-SP/OS, T-KJr2-IN/OS, T-K4-IN/OS

Item #	Part #	Description	Common parts for other models
410	EKK2E	Outlet drain plug	T-K3, T-K3-Pro, T-K3-SP/OS, T-KJr2-IN/OS, T-K4-IN/OS, T-M50
411	EKK2T	Output thermistor	T-K3, T-K3-Pro, T-H2-DV/OS, T-M50, T-M32
412	EKN34	Hi-Limit switch	T-K3, T-K3-Pro, T-K3-SP/OS, T-H2-DV/OS, T-M50, T-M32
413	EK333	Overheat-cut-off fuse	T-K3, T-K3-Pro, T-K3-SP/OS, T-KJr2-IN/OS, T-K4-IN/OS, T-M50
414	EKK2R	Heater	T-K3, T-K3-Pro, T-K3-SP/OS, T-KJr2-IN/OS, T-K4-IN/OS
415	EKK2P	Inlet heater	T-K3, T-K3-Pro, T-K3-SP/OS, T-H2-DV/OS, T-KJr2-IN/OS, T-K4-IN/OS, T-M32
450	EKK27	Pipe heater fixing plate	T-K3, T-K3-Pro, T-K3-SP/OS, T-H2-DV/OS, T-KJr2-IN/OS, T-K4-IN/OS, T-M50, T-M32
451	EK031	Heater fixing plate 16	T-H2-DV/OS, T-KJr2-IN/OS, T-K4-IN/OS, T-M50, T-M32
452	EKK26	Fuse fixing plate 18	T-K3, T-K3-Pro, T-K3-SP/OS, T-H2-DV/OS, T-KJr2-IN/OS, T-K4-IN/OS, T-M50, T-M32
453	EK029	Fuse fixing plate 14	T-K3, T-K3-Pro, T-K3-SP/OS, T-KJr2-IN/OS, T-K4-IN/OS
454	EZM04	O-ring P4 FKM	T-K3, T-K3-Pro, T-K3-SP/OS, T-H2-DV/OS, T-KJr2-IN/OS, T-K4-IN/OS, T-M50, T-M32
455	EZM06	O-ring P6 FKM	T-K3, T-K3-Pro, T-K3-SP/OS, T-H2-DV/OS, T-KJr2-IN/OS, T-K4-IN/OS, T-M50, T-M32
456	EZM14	O-ring P14 FKM	T-K3, T-K3-Pro, T-K3-SP/OS, T-H2-DV/OS, T-KJr2-IN/OS, T-K4-IN/OS
457	EZM15	O-ring P15 FKM	T-K3, T-K3-Pro, T-K3-SP/OS, T-H2-DV/OS, T-KJr2-IN/OS, T-K4-IN/OS, T-M50, T-M32
458	EZM16	O-ring P16 FKM	T-K3, T-K3-Pro, T-K3-SP/OS, T-H2-DV/OS, T-KJr2-IN/OS, T-K4-IN/OS, T-M50, T-M32
459	EKH30	Fastener “4-11”	T-K3, T-K3-Pro, T-H2-DV/OS, T-M50, T-M32
460	EKK24	Fastener “14-22”	T-K3, T-K3-Pro, T-K3-SP/OS, T-H2-DV/OS, T-KJr2-IN/OS, T-K4-IN/OS

Item #	Part #	Description	Common parts for other models
461	EM192	Fastener “16A”	T-K3, T-K3-Pro, T-K3-SP/OS, T-KJr2-IN/OS, T-K4-IN/OS
462	EKK39	Fastener “16-25A”	T-K3, T-K3-Pro
463	EKN50	Silicon ring	T-K3, T-K3-Pro, T-K3-SP, T-H2-DV, T-KJr2-IN/OS, T-K4-IN/OS, T-M32
701	EK439	Computer board	
702	EKH09	Transformer	T-K3, T-K3-Pro, T-K3-SP/OS, T-KJr2-IN/OS, T-K4-IN/OS
703	EK428	Surge box	T-KJr2-IN/OS, T-K4-IN/OS
704	EKK3C	120VAC wire	T-K3-SP/OS, T-H2-DV/OS, T-K4-IN/OS
705	EK440	Transformer wire	T-K4-IN/OS
706	EKK4V	120 VAC Power ON-OFF switch	T-K3-SP/OS, T-H2-DV/OS, T-KJr2-IN/OS, T-K4-IN/OS
707	EK441	Switch wire	T-K4-IN/OS
708	EKK10	Gas valve wire	T-K3, T-K3-Pro
709	EKK11	Flame rod wire	T-K3, T-K3-Pro
710	EKK0Z	EH-IG wire	T-K3, T-K3-Pro
	EKK40	EH-IG wire with freeze protection thermostat	T-K3-OS, T-KJr2-OS, T-K4-OS
711	EKN74	Igniter	T-K3, T-K3-Pro, T-K3-SP/OS, T-H2-DV/OS, T-KJr2-IN/OS, T-K4-IN/OS, T-M50, T-M32
712	EKK2M	High voltage igniter cable	T-K3, T-K3-Pro, T-K3-SP/OS, T-H2-DV/OS, T-KJr2-IN/OS, T-K4-IN/OS, T-M50
713	EKJ59	Freeze protection thermostat	T-K3, T-K3-Pro , T-K3-SP, T-KJr2-IN, T-K4-IN, T-M32
714	EKK12	Proportional gas valve wire	T-K3, T-K3-Pro, T-H2-DV/OS
715	EKK36	Pump and multi cable	T-K3, T-K3-Pro
716	EKK1Z	Thermistors wire	T-K3, T-K3-Pro
717	EKK35	RS-VG wire	T-K3, T-K3-Pro
718	EKK33	Water valves wire	T-K3, T-K3-Pro
719	EKK1M	Computer board cover	T-K3, T-K3-Pro , T-M50

15. Revisions

Version	Description of changes	Date
1.00	First edition	11/01/10