

EW(A/Y)T-CZ

Air cooled chiller and
heat pump with inverter
scroll compressor

DHW Management



EWAT-CZ
EWYT-CZ

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1. DOMESTIC HOT WATER

This document describes all features of DHW option for production of domestic hot water in both single and multi-chiller applications with two separated water loops, one for normal operation and one for this option.

Basic set up of the DHW control requires to set one simple parameter available in the unit configuration menu.

Notice that, for Web HMI, the Connectivity Kit is required.

HMI EVCO Parameters

Parameter	Default	Range	Description
[15.09] DHW Enable	0	0 = Disabled 1 = Enabled	After a restart of the UC the function will be enabled to start

Web HMI Path : Main Menu → Commission Unit → Configure Unit → Options

Setpoint/Sub Menu	Default	Range	Description
Domestic Hot Water	Disable	Disable, Enable	After a restart of the UC the function will be enabled to start

2. SET-UP

In case the Domestic Hot Water option is selected, the control system is improved to manage a secondary circuit to produce domestic hot water. The water is stored in a tank and its temperature is controlled by one immersion probe. The temperature is raised by the source passing technical water in a coil inside the tank.

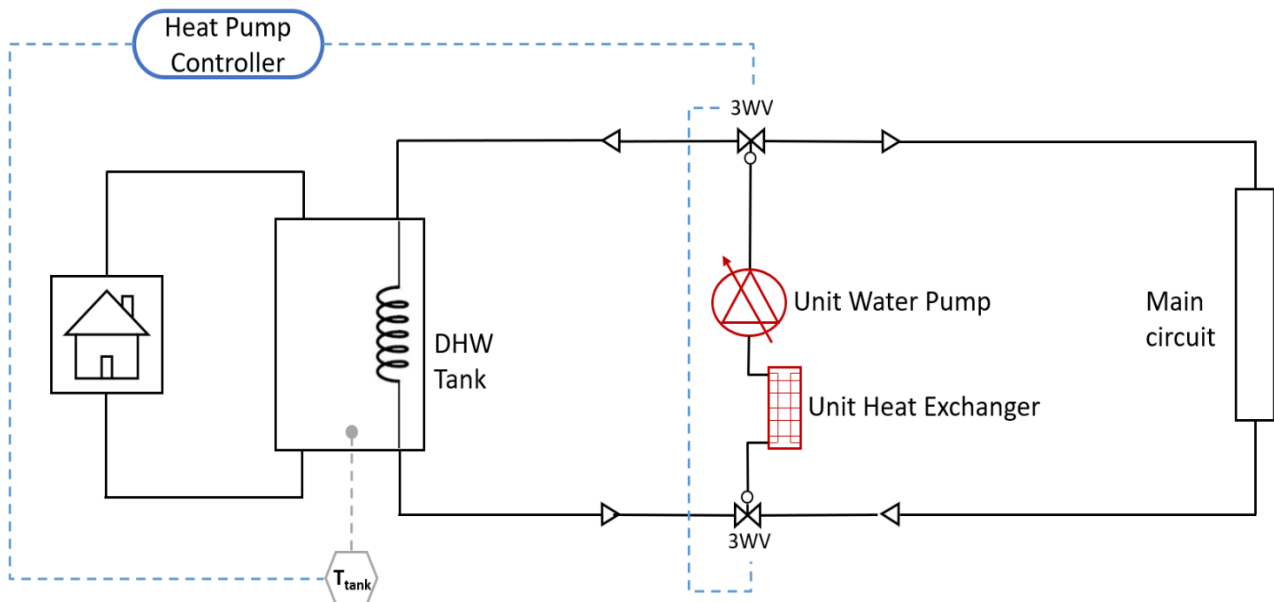
Use of the function will require the addition of the following components to the system:

- Temperature Sensor Tank
Used for monitoring the temperature of the water inside the storage tank.
- 3-Way Valve
Manages which one of the two loops (terminal or tank loop) exchanges heat with the unit in operation. 3WV default position must be the one associated with main circuit loop.

2.1 Single-Unit

This configuration temporarily stops capacity exchange with main circuit to allow water tank heating.

In this DHW system, the pump speed control must be set to “On-Off” or “Fixed Speed” (please refer to proper VPF documentation for this setting) while T_{tank} – Tank Temperature transducer must be an NTC-10K probe.



Please note that during DHW operation VPF functions are not allowed. Check unit configuration before start.

2.2 Multi-Unit

For Multi-Unit setup, M/S functionality needs to be enabled on all units (please refer to M/S documentation for this setting). Tank setpoint, Start Db and Delay of DHW function will follow master's parameter values. In the same way, also the 3WV and DHW functional steps are managed only by master.

For this reason, master must be physically connected to 3WV on water circuit.

In this DHW system, the pump speed control must be set to “On-Off” or “Fixed Speed” (please refer to proper VPF documentation for this setting) while T_{tank} – Tank Temperature transducer must be an NTC-10K probe.

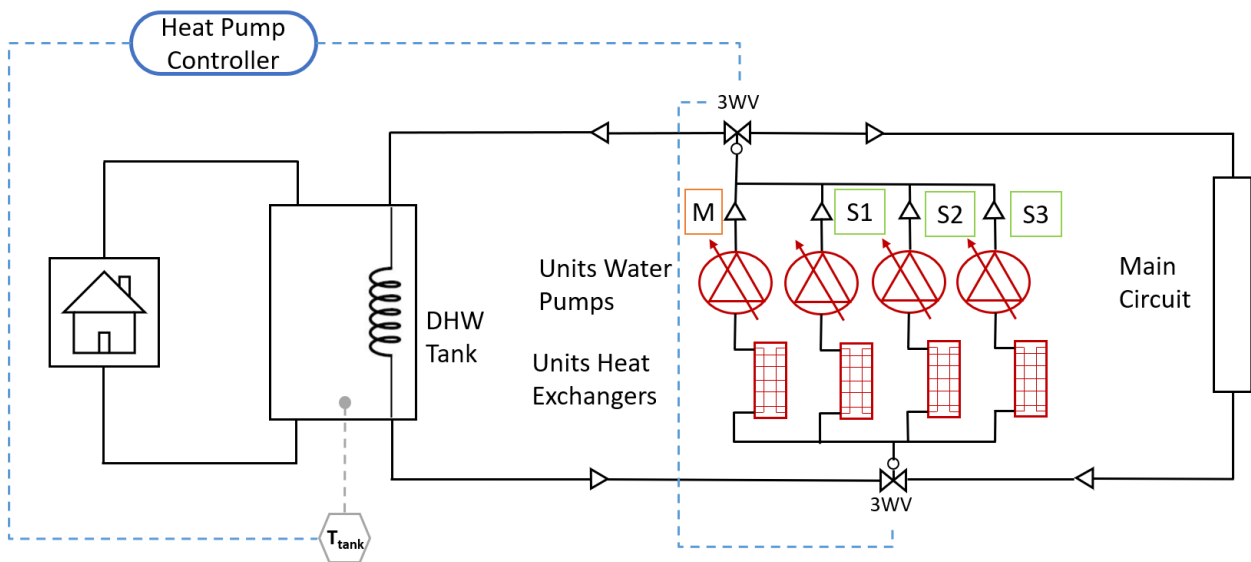
Moreover, several parameters must be set to have whole the plant working properly.
In particular:

1. **DHW Enable Setpoint.** Domestic Hot water function must be enabled in all units, master and slaves, that participate to the tank heating
2. **Remote Enable Setpoint**
Slaves units cannot have IO Ext Module and require to enable via software the DHW function. This setpoint replaces the physical digital input and must be set ON for all slaves connected to tank water circuit.
3. **IO Extension Module Setpoint**
The extension module must be enabled on Master unit and disabled on all Slaves units.
4. **DIP Switch on Slave's IO Extension Module**
If a slave has the IO Extension Module connected on Modbus network, all its DIP switches need to be set to OFF.
5. **Standby Setpoint**
Master and slaves connected to tank water circuit must have same the value on Standby Mode Setpoint

When M/S and DHW function are both enabled there are 2 possible cases:

a) DHW Total

All units in the plant participate to DHW function. M/S and DHW functionalities need to be enabled on all units. The following image shows a 4-units example.



DHW Total Configuration Scheme

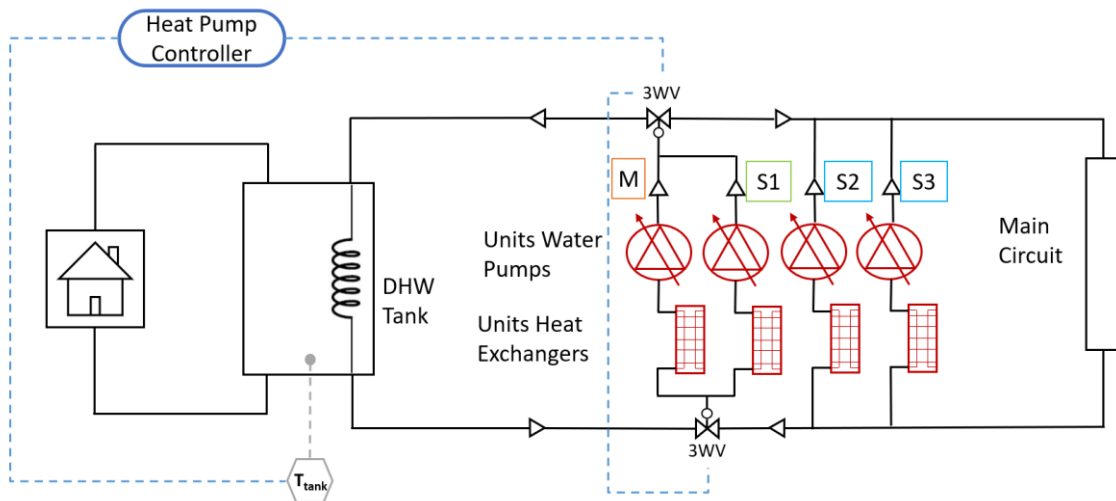
In case "(a) DHW Total", the parameters needed for this setup can be summarized in the following table:

Unit	DHW En	Remote En	IoExtModEn	Standby En	DIP Switches
Master	On	Off	On	On/Off	Address
Slave #1	On	On	Off	On/Off***	All Off
Slave #2	On	On	Off	On/Off***	All Off
Slave #3	On	On	Off	On/Off***	All Off

***Slaves' operating in DHW must have Standby En set as master.

b) DHW Partial

Some units participate to DHW function while others are connected only to Main Circuit. This configuration allows Tank Heating and Space Heating/Cooling at the same time. The Following image shows a 4-units example with master and one slave participating to DHW functionality.



DHW Partial Configuration Scheme

In case “(b) DHW Partial”, the parameters needed for this setup can be summarized in the following table:

Unit	DHW En	Remote En	IoExtModEn	Standby En	DIP Switches
Master	On	Off	On	On/Off	Address
Slave #1	On	On	Off	On/Off***	All Off
Slave #2	Off	Off	Off	Off	All Off
Slave #3	Off	Off	Off	Off	All Off

***Slaves' operating in DHW must have Standby En set as master



Please note that unit's parameters settings must match plant configuration for both “DHW Total” and “DHW Partial”



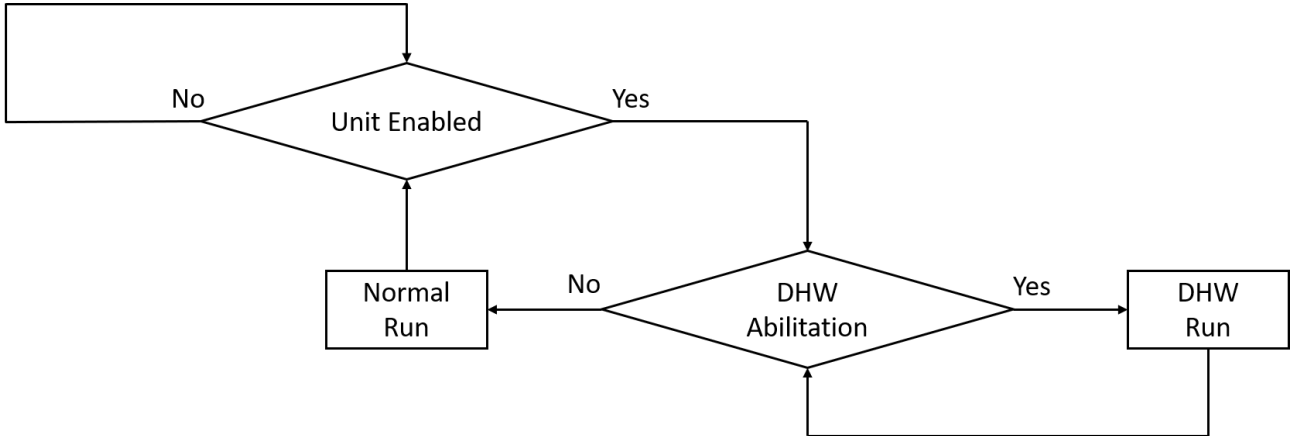
Previous tables refer only to the examples shown in the images above.

3. DHW CONTROL

The production of domestic hot water takes place in "parallel" to the normal operation of the unit. When the machine is running and all DHW start conditions are reached, the unit performs the following steps:

1. Unit Pump-Down (go to 2. if Unit State = Off)
2. Water pump Shutdown
3. 3WV changeover
4. Unit Restart

Once the desired target has been reached or the DHW start conditions are no longer met, the unit will return to standard operating mode and will be restarted, as shown in the graph below:



Specifically, the following table shows the starting condition for DHW:

IF	AND	Unit Enabled	
		3WV on Main Circuit	
		DHW Enabled	
		OR	Digital Input
			BMS Input (Remote Input)
		Unit Mode Cool/Heat Pump	
		Pump Control "On-Off" or "FixSpd"	
	Analog Input		
	NOT	Unit Alarm	
	NOT	Timer Active	
THEN	DHW Start		

Notice that in the starting conditions of the function the enabling of the unit is also present and this means that, if the unit is turned off via unit switch or enable, the 3WV will be returned to the standard position (Main Circuit Loop).

In this scenario there are two distinct inputs that enable/disable the DHW function, digital and analog, both required to go to DHW mode.

3.1 Digital Input

This input can come from an external system, a contact from a simple thermostat or overwritten via BMS/HMI.

In the digital input management, after UC activates the DHW function, the unit gradually reaches 100% capacity to satisfy the DHW request as soon as possible. When the digital input is deactivated, production of domestic hot water ends, and the unit returns to the conditions prior to the activation of the function.

- If you want to make the function dependent on the Digital Input only, it is necessary to set the maximum possible value as target of DHW. In this case, if the unit does not activate DHW mode it is because the water temperature inside the tank is above the allowed limits of the machine.

3.2 Analog Input

In this case it is an immersion probe placed inside the tank and some parameters need to be configured:

- DHW Setpoint: tank water temperature target
- DHW StartDT: activation threshold of the function below the setpoint
- DHW Delay: delay between two different starts of DHW function

These three parameters together with the reading of the probe placed inside the water tank (T_{tank}), determine the execution logic of the DHW function:

If $T_{\text{tank}} < \text{MIN}[\text{DHW Setpoint} - \text{DHW StartDT}, \text{Maximum HP Lwt}] \rightarrow \text{Analog Input} = \text{TRUE}$

DHW operations will terminate if this condition is no longer true.

- If you want to make the function dependent only on the Analog Input, it is necessary to short the external module associated Digital Input with GND.

3.3 3-Way Valve

The three-way valve takes care of the deviation of the water flow from the primary circuit to the tank in case of activation of the DHW function. This is automatically managed by the UC during operations. There are two different types of valves:

- **Feedback Valve**
This valve requires a digital enable input to divert the flow in one or the other direction and returns the valve start/end position via two digital outputs.
- **Temporized Valve**
This type of valve has only the digital enabling input and guarantees the complete switch at a certain time without returning feedback on the real position of the valve. Such a valve requires the configuration of a timer for switching operations.

3.4 Standby Mode

Unit can be configured to operate only on tank circuit activating a function called "Standby Mode", during which space heating/cooling is not allowed.

During "standby operations" the 3WV is always connected to Tank circuit and unit will start/stop to guarantee water tank setpoint.

- In case of Multi-Units setup, if master is configured to operate in "Standby Mode" all slaves connected to tank water circuit must have the same configuration.

3.5 SIC - Heating Customized Functionalities

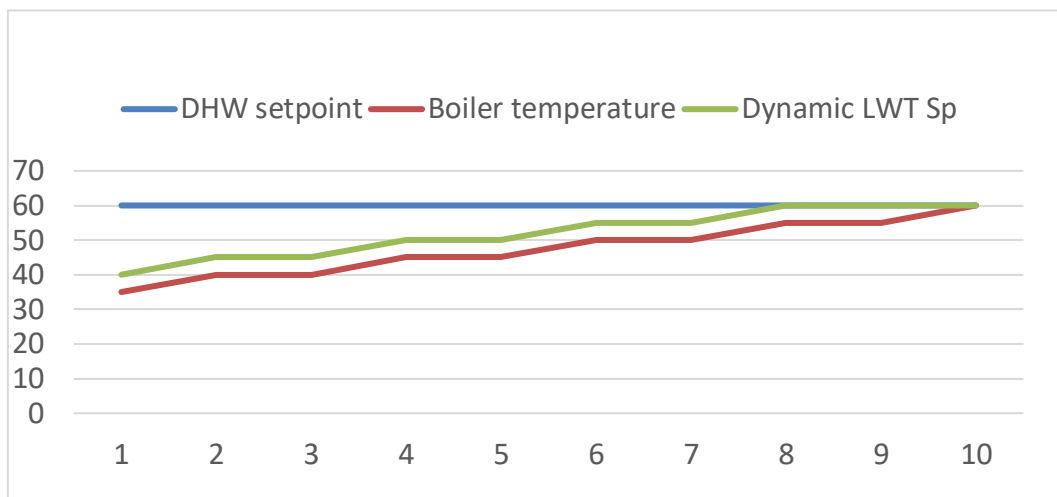
This chapter describes the feature introduced thanks to the accessory : SIC – Heating Customized for both Single-Unit and Multi-Unit cases.



NOTICE: *Following features will be available only with the accessory EKRSCIOH**

3.5.1 Leaving Water Temperature control Target

During normal DHW functionalities the unit loads quickly with a target equal to its maximum leaving water temperature available in heat pump mode. It's possible to change this target forcing it to be equal to the actual water temperature inside the tank plus 5°C.



So, with “Leaving water Temperature control Target” operation, the unit will have a dynamic setpoint which will increase or decrease depending on the tank temperature in order to:

- Reduce temperature delta between leaving water temperature and tank temperature.
- Increase DHW’s heat exchange efficiency.

3.5.2 Pump Secondary Fixed speed

When primary water loop and domestic hot water loop require different flows, it’s possible to enable this function in order to automatically force pump to its second fixed speed during DHW operations.

- Inverter pump required.
- Fixed speed functionality enabling required (please refer to proper documentation).

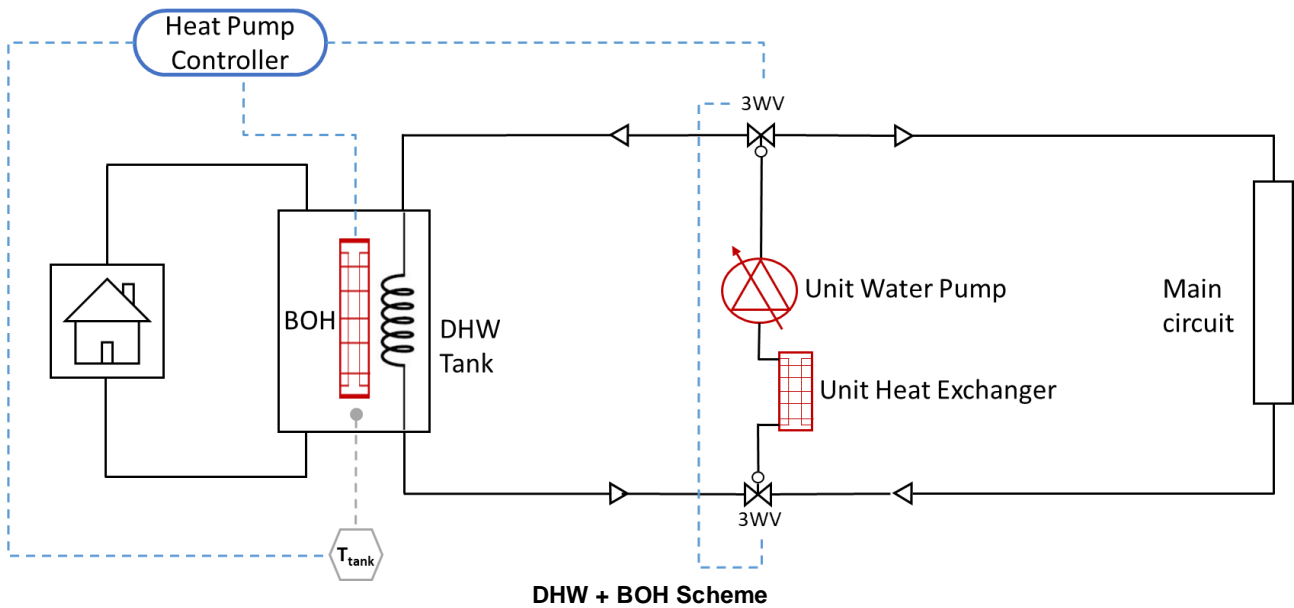
In this situation unit will use primary for main water circuit and second speed for DHW water circuit respectively.

- Both speeds need to be set via Fixed speed menu (please refer to proper documentation).

3.5.3 Booster Heater output

This function allows the generation of a dedicated output for the activation of booster heater inside water tanks in case of:

- Unit fault.
- Defrost.
- Water tank setpoint out of unit envelope.
- Excessive DHW operation time.



3.5.3.1 Activation Conditions

Activation logic (BOH = On) can be divided into 2 different sections:

- Generic logic condition
Active even if the unit is connected to the main water circuit.

TON(10s)	OR	DHW_Sp - DHW_StartDB > TankT > MaxEnvLwtHp	
		AND	DHW_Abilitation = On
		OR	UnitFault SCM_DHWUnitFault

- DHW logic condition
Active only if unit the is connected to the DHW water circuit when unit is in alarm, defrost or disconnected by comfort water loop for too much time:

OR	Gen_BOH_Alm_Defr
	Gen_BOH_MaxTime

Gen_BOH_MaxTime:

TON (DHWMaxTime/2)	AND	DHW_Regulation
		NOT DHWnotToAuto

Gen_BOH_Alm_Defr:

TON(10s)	OR	AND	DHWRegulation
			OR
		AND	DHWRegulation
			OR

3.5.3.2 Deactivation conditions

Deactivation logic has a higher priority respect to activation one and can be summarized as follows.

OR	DHWTankTemp > DHWTankSp
	NOT(UnitEnabled)
	BOH = On for 30 minutes

NB

- Deactivation timer is reset if BOH is activated for unit fault or defrost operation in DHW loop.
- BOH can be activated for a thermoregulation reason (no unit fault or unit defrost) only 4 time per day (one every 6 hours) for both DHW's normal and standby modes.

4. DHW SETUP MENU

The table below reports all writable and readable parameters available in DHW Settings menu when function is enabled.

EVCO HMI Parameters

Menu	Parameter	Default	Range	Description
[19] DHW	[19.00] Setpoint	45	0..Max Heating Sp	Temperature target for tank water.
	[19.01] Start Db	2	0..10 °C	Allowed tank water temperature delta under setpoint before DHW function is called.
	[19.02] Delay	30	0..600min	Delay between two DHW function calls.
	[19.03] Temperature	-	°C	Actual water temperature inside tank.
	[19.04] 3wv State	-	0..1	0 = Terminal Loop 1 = Tank Loop
	[19.05] DHW Alarm Code	-	0..31	DHW Alarm word. Each bit represents: Bit_0 =Double Position Error Bit_1 =Lost Start Position Reference Bit_2 =Lost End Position Reference Bit_3 =3WV Switch Fail Bit_4 =Temperature Sensor Fault
	[19.06] 3wv Type	0	0..1	0 = Feedback 1 = Temporized
	[19.07] 3wv Switch Time	300	0..900sec	Required time for temporized valve to execute a full path switch. If 3WVs equipped with physical feedbacks are used, its value defines the alarm delay for valve reference loss.
	[19.08] Max Time	30	0..1440min	Defines maximum time during which DHW function can be active. Once elapsed this time, unit stops and 3WV is switched back on primary circuit and will not operate in DHW for at least a "Delay" time.
	[19.09] Standby Mode	0	0..1	0 = Standby Mode Disabled 1 = Standby Mode Enabled
	[19.10] Remote En	2	0..2	Represents a software function enabling that replaces digital input: 0 = Disable 1 = Enable 2 = NULL
	[19.11] Units State	-	0000..4444	Represents current DHW state of the units connected in the network: 0 = DHW Off 1 = DHW Run 2 = DHW Standby 3 = DHW Unavailable 4 = DHW Alarm
	[19.12] Lwt Target Ctrl	0	0..1	Enables the Leaving Water Temperature control target function
[19.13] Double Fixed Speed	0	0..1	Enables the automatic pump fixed speed change during DHW operations	

All parameters can be configured in Web HMI at path:

"Main Menu -> Commission Unit -> Configure Unit -> DHW Settings"

5. TROUBLESHOOTING

In this section are reported all alarms related to the domestic hot water functions and relative troubleshooting. Basically, all DHW errors can be divided into two different types: 3WV fault or Sensor Fault.

5.1 3WV Fault

A 3WV fault can be related to connection/wiring issue or to component break up and are available only in temporized valve configuration.

Symptom	Cause	Solution
EVCO HMI's register [07.00] report value [U016] and Bit_0, Bit_1, Bit2_ or Bit_3 of register [19.05]'s value is different from 0 Bell's led of Web HMI (Connectivity kit required) is blinking String in the alarm list: +UnitOffDHWAlarm String in the alarm log: ± UnitOffDHWAlarm String in the alarm snapshot: L UnitOffDHWAlarm	Errors in sensor wiring/connection.	Check valve's cabling. Check 3WV.

5.2 Sensor Fault

This alarm can occur when the sensor used to measure the water temperature into tank is broken or not properly connected to chiller.

Symptom	Cause	Solution
EVCO HMI's bit_4 of register [19.05]'s value is different from 0 Bell's led of Web HMI (Connectivity kit required) is blinking.	Errors in sensor wiring/connection.	Check sensor's cabling.

Notice that, in case of sensors fail during DHW operation, the 3WV returned in default position and normal unit operation are allowed.

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