



REV	00
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**Bivalent Operation Management
D-EIOOC01108-23_00EN**

Air to water heat pump units with scroll compressors

EWYT~CZ / EWAT~CZ

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1. BIVALENT OPERATION

This document describes the features of the Bivalent Operation option for creating cascade systems between a heat pump and a boiler in the case of single-unit systems only (multi-chiller application is not compatible).

Basic set up of the Bivalent Operation control first requires set one parameter available in the unit configuration menu and secondly to activate the functionality itself with its own enable parameter.

HMI EVCO Parameters

Parameter	Default	Range	Description
[15.12] Heating Customized Enable	0	0 = Disabled 1 = Enabled	After a restart of the UC the function will be enabled to start
[27.00] Bivalent Operation Enable	0	0 = Disabled 1 = Enabled	External boiler management will be activated after setting this parameter equal to one. Changing to Enabled requires unit to be disabled and in heat pump mode.

Web HMI Path: Main Menu→Commission Unit→Configure Unit→BivOps Settings

Web HMI Path: Main Menu→Commission Unit→Configuration→Bivalent Ops Settings

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

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



Bivalent Operation

This functionality is available only with EKRSCIOH - IO extension for Heating Application accessory. Enabling Heating Customized without accessory module connected to the unit won't allow Bivalent Operation start.

2. SET-UP

In case the Bivalent Operation option is selected the control system is improved to manage an external boiler to produce a System Leaving Water for space heating only allowing “out-of-unit’s envelope” temperature production and unit fails/defrost compensation.

Temperature of water produced by the heat-pump is raised up to system target via the boiler depending on outside temperature. After that, water is used in the system plant and turns back as System Entering Water with a decreased temperature of pre-configured system delta T.

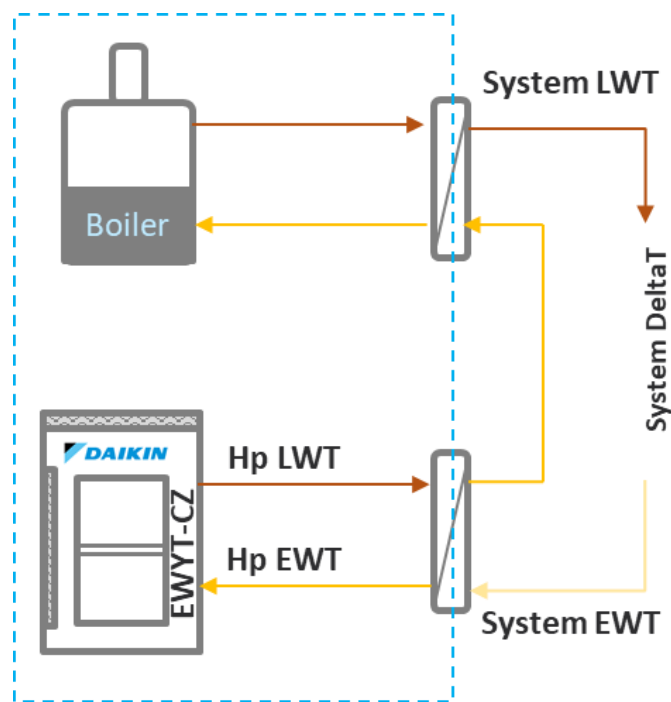
Use of the function will not require the addition of components to the system and boiler managing is made via a single digital output.

This implementation requires setting the same climatic curve in both boiler and heat-pump.

2.1 Single-Unit HP and Boiler hybrid system

Following scheme represents a cascade configuration for a hybrid system with heat exchanger but hydraulic separator or buffer tanks can be used too.

In this BivOps system, the pump speed control must be set to “On-Off” or “Fixed Speed” (please refer to proper VPF documentation for this setting).



Please note that during Bivalent Operation M/S, Collective Housing and DHW functions are not allowed. Check unit configuration before start.

3. BIVALENT OPERATION CONTROL

The production of system leaving hot water takes place in series to the normal operation of the unit without need of unit stops or water changeovers.

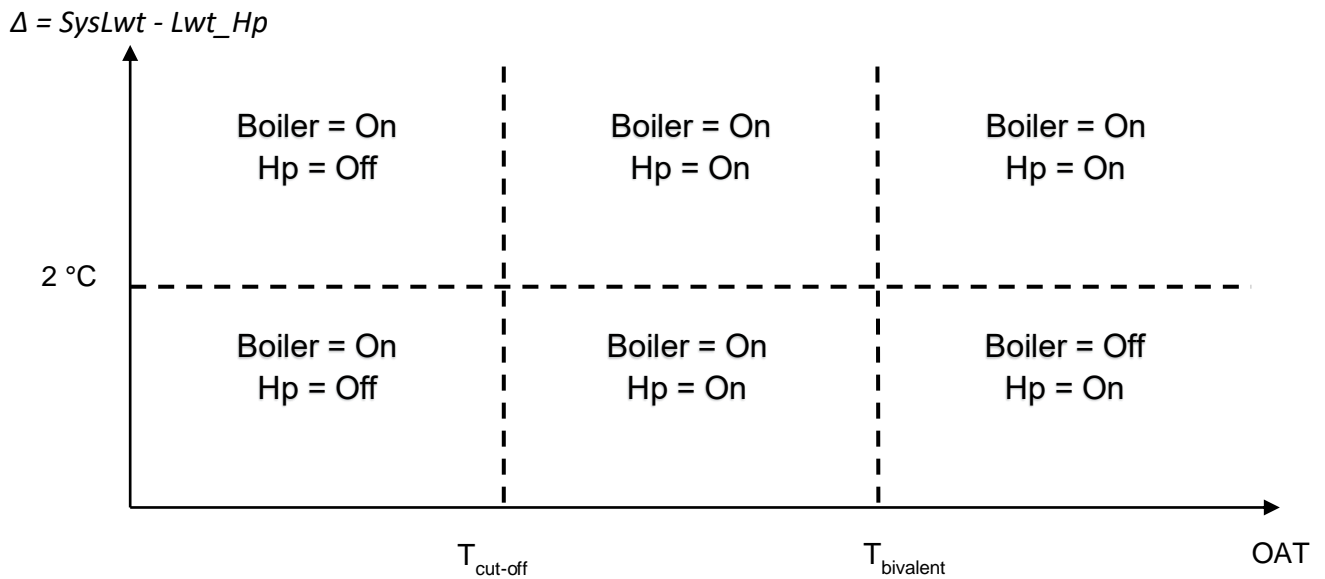
Control logic of Bivalent Operation can be divided into 3 different sections:

1. Bivalent Operation output
2. Climatic Curve generation
3. Heat-Pump setpoint generation

3.1 Bivalent Operation output

Depending on ambient temperature and related unit efficiency, it is possible to have 3 different working condition:

- Only Heat-Pump active
- Both Heat-Pump and Boiler active
- Only Boiler active



As shown in the figure above, when OAT is too low and HP efficiency is lower than Boiler one, the unit is disabled and vice versa at high ambient temperature.

Is possible to have transitions during which SystemLwt required is not reached by heat-pump even if $OAT > T_{bivalent}$. In this case, boiler is temporary activated too:

$$\Delta = SysLwt - Lwt_{Hp} > 2^{\circ}C$$

Temperature range where bivalent operation takes place is:

$$T_{cut-off} < OAT < T_{bivalent}$$

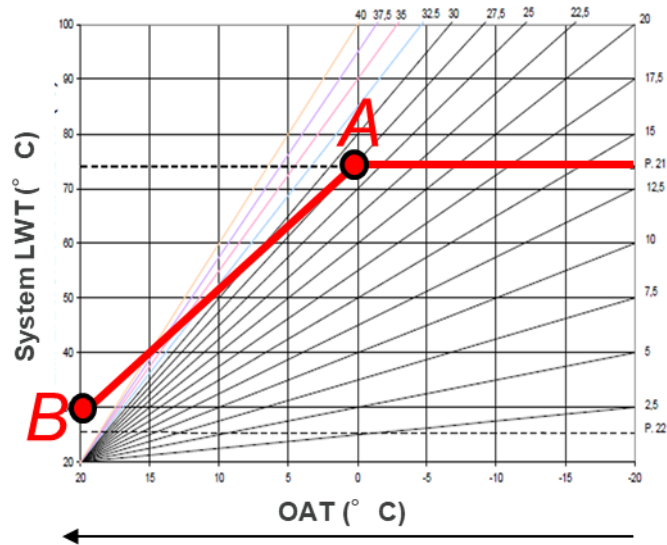
NB

During bivalent operation the heat-pump is activated before the boiler. Delay between two activations can be set via HMIs.

3.2 Curve generation

To define when to activate/deactivate the boiler and which setpoint is required for the heat pump to reach the System Lwt, it is necessary to set the climatic curve of the system, approximating it with a straight line, on the heat pump in an identical manner to that present on the boiler.

- Climatic curve is limited by the maximum system leaving water temperature value (75°C)



The System LWT is generated from the straight line passing through two points, A = (Tdesign; SystemLwtDesign) and B = (20°C, SystemLwt@20) in the figure, defined by 3 setpoints as the Tambient at extreme point B fixed at 20 °C.

Setpoint to be configured before start bivalent operation are:

- The System Lwt at 20°C
- The System Lwt at system design temperature
- The Design Temperature for the system

3.3 Heat-Pump dynamic setpoint generation

During the Bivalent Operation, the Heat-pump setpoint is calculated dynamically starting from the Entering Water Temperature with the aim of maximizing the water temperature delta available to the unit according to the environmental conditions.

In particular, logic for setpoint calculation can be divided into 2 cases:

1. **System $\Delta T > 5^{\circ}\text{C}$**
 - LWT_hp_setpoint = Min Value [System LWT; EWThp + ΔT_{hp} (5°C)] if Tcut-off < OAT < 7°C
 - LWT_hp_setpoint = Min Value [System LWT; EWThp + ΔT_{hp} (8°C)] if OAT > 7°C
2. **System $\Delta T \leq 5^{\circ}\text{C}$**
 - LWT_hp_setpoint = Min Value [System LWT; EWTHP + ΔT_{hp} (5°C)]

NB

LWT_hp_setpoint is always minor or equal than System LWT required.

4. BIVALENT OPERATION SETUP MENU

Table below reports all writable and readable parameters available in Bivalent Operation Settings menu when function is enabled.

EVCO HMI Parameters

Menu	Parameter	Default	Range	Description
[27] Bivalent Operatio n	[27.00] Bivalent Ops En	0	Off/On	Allows bivalent operation mode to start.
	[27.01] Tamb Design	0	-20...60	Defines design ambient temperature for the system.
	[27.02] System Lwt Design	60	20...75	Defines system leaving water temperature target for the system at design ambient temperature.
	[27.03] System Lwt@20	30	20...75	Defines system leaving water temperature target for the system at 20°C ambient temperature.
	[27.04] Tcut-off	0	-7...7	Defines lower limit for bivalent operation under which only boiler is enabled.
	[27.05] Tbivalent	7	0...20	Defines higher limit for bivalent operation over which only heat-pump is enabled. Is it possible to have transition with boiler active even if OAT > Tambient.
	[27.06] System DeltaT	10	0...50	This parameter shall match the exact delta temperature drop due to system load.
	[27.07] Boiler Delay	15	0...60	Defines activation delay between heat-pump and boiler in bivalent operation OAT range.

All parameters can be configured in Web HMI at path:

“Main Menu→Commission Unit→Configuration→Bivalent Ops Settings”

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