



REV	02
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Bivalent Operation Management D-EIOOC01108-23_02EN

Air to water heat pump units with scroll compressors

EWYT~CZ / EWAT~CZ

EWYE~CZ

EWYK~CZ / EWAK~CZ

EWYK-QZ

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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 (Only EWA(Y)T-CZ and EWYE-CZ series)

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/Siemens HMI Path: Main Menu→Commission Unit→Configure Unit→BivOps Settings

Web/Siemens 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 (Only EWA(Y)T-CZ and EWYE-CZ series)



Bivalent Operation

This functionality is available only with EKRSCIOC for EWYE series or with EKRSCIOH - IO extension in Heating Application accessory for EWYT series or EKRSCIOR /EKRSCM (with SCM Standard) for EWYK-CZ.

Enabling Heating Customized without accessory module connected to the unit won't allow Bivalent Operation start.

Enabling Heating Customized is not required in EWYK-QZ series.

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).

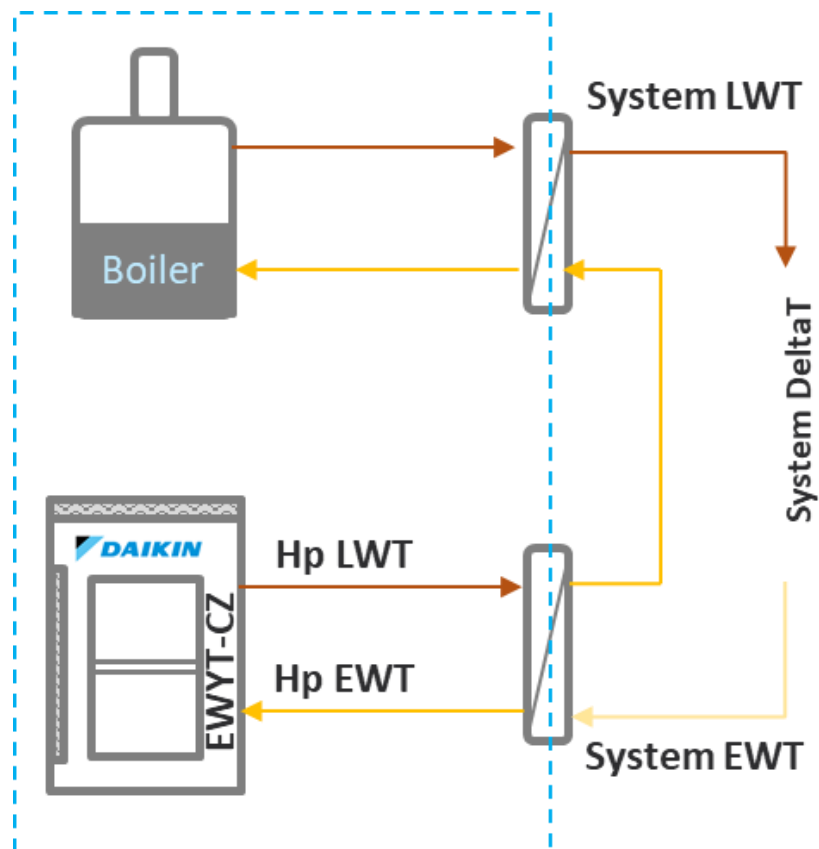


Figure 1- Plant Scheme for EWYT-CZ single unit series

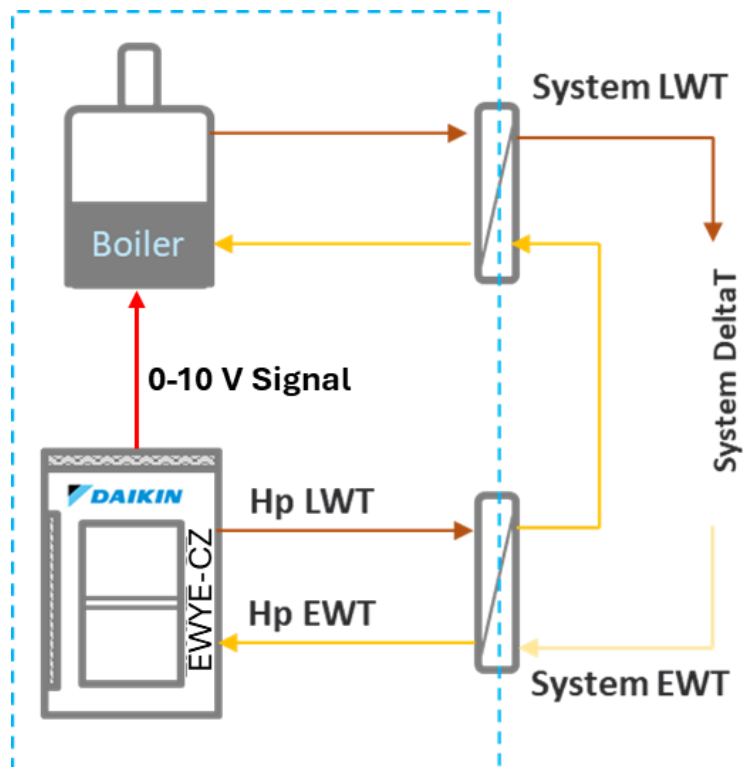


Figure 2-Plant Scheme for EWYE-CZ single unit series with 0-10V signal from HP to Boiler



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

2.2 Multi-Unit HP and Boiler hybrid system

For Multi-Unit setup, M/S / iCM functionality needs to be enabled on all units (please refer to M/S or iCM documentation for this setting).

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

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

In particular:

1. Bivalent Operations Enable function must be enabled in all units, master and slaves.
 - a. In EWYK-QZ series only on master unit
2. IO Extension Module Setpoint
The extension module must be enabled on Master unit and disabled on all Slaves units.
3. Domestic Hot Water Enable Setpoint and Collective Housing Enable Setpoint must be disabled in all 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.

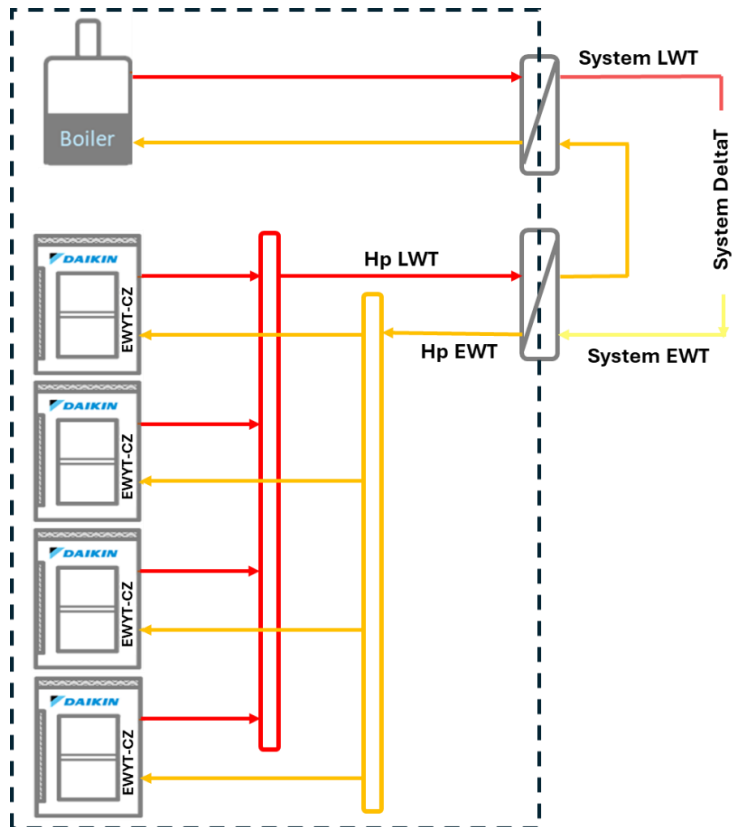


Figure 3- Plant Scheme for EWYT-CZ multi unit series

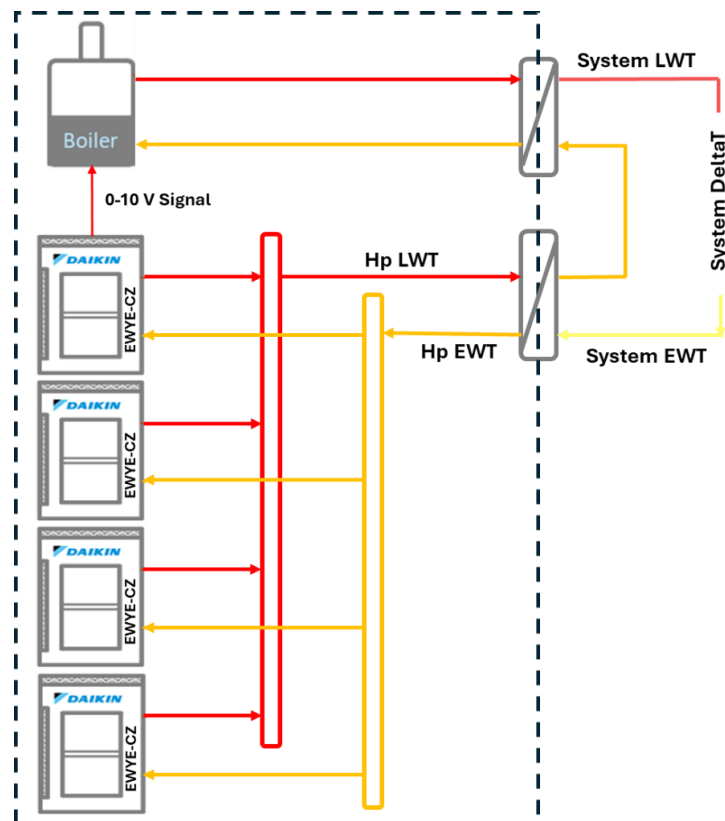


Figure 4-Plant Scheme for EWYE-CZ multi unit series with 0-10V signal from HP to Boiler



In EWYK-QZ series MUSE arrays should be considered as a single Master/Slave unit, for both series/parallel layout.

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.

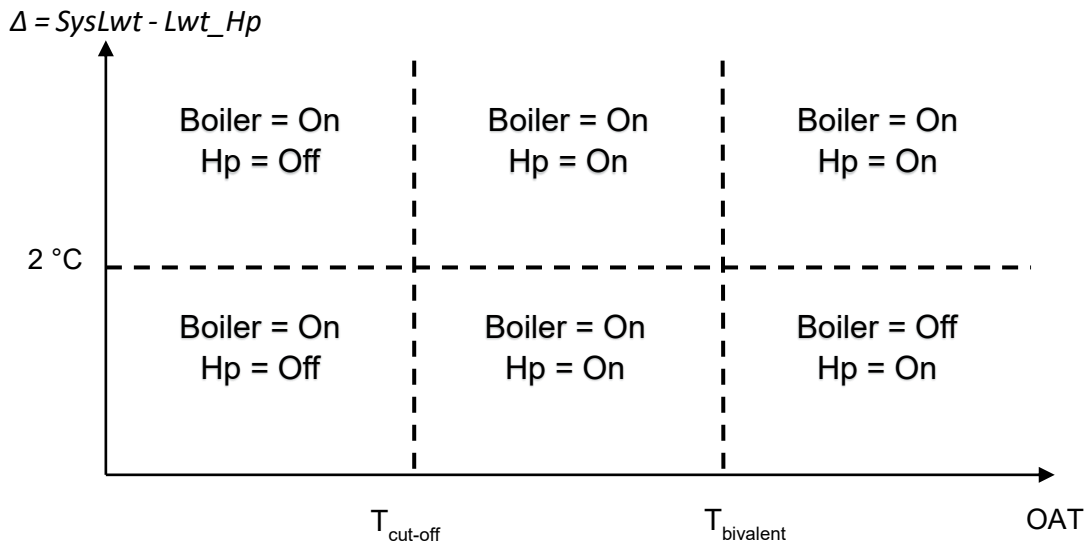
Control logic of Bivalent Operation can be divided into 3 different sections:

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, is it 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:

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

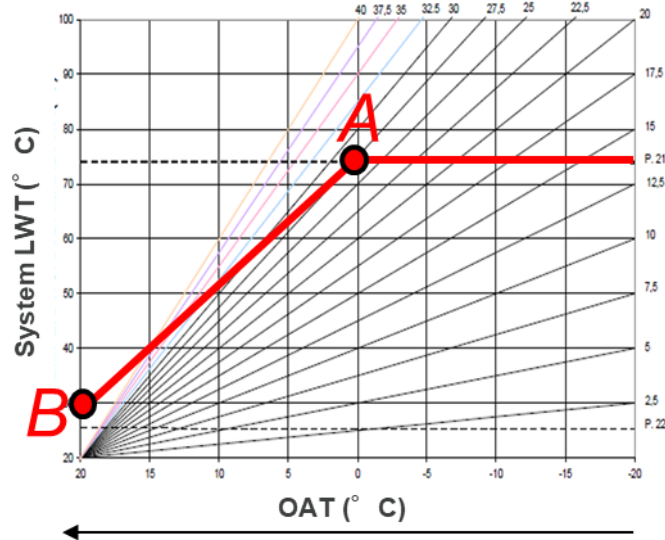
NB

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 $\Delta T > 5^{\circ}\text{C}$**
 - $\text{LWT}_{\text{hp_setpoint}} = \text{Min Value} [\text{System LWT}; \text{EWThp} + \Delta\text{Thp} (5^{\circ}\text{C})]$ if $T_{\text{cut-off}} < \text{OAT} < 7^{\circ}\text{C}$
 - $\text{LWT}_{\text{hp_setpoint}} = \text{Min Value} [\text{System LWT}; \text{EWThp} + \Delta\text{Thp} (8^{\circ}\text{C})]$ if $\text{OAT} > 7^{\circ}\text{C}$
- 2. System $\Delta T \leq 5^{\circ}\text{C}$**
 - $\text{LWT}_{\text{hp_setpoint}} = \text{Min Value} [\text{System LWT}; \text{EWThp} + \Delta\text{Thp} (5^{\circ}\text{C})]$

NB

$\text{LWT}_{\text{hp_setpoint}}$ is always minor or equal than System LWT required.

3.4 System LWT by 0-10V signal (Only for EWYE-CZ, EWYK-CZ and EWYK-QZ series)

The System LWT target is sent to Boiler via 0-10V signal: 0 V corresponds to System Lwt@20, i.e. Boiler Setpoint = System LWT@20, whereas 10 V corresponds to System Lwt Design, i.e. Boiler Setpoint = System LWT Design, as shown in the following picture:

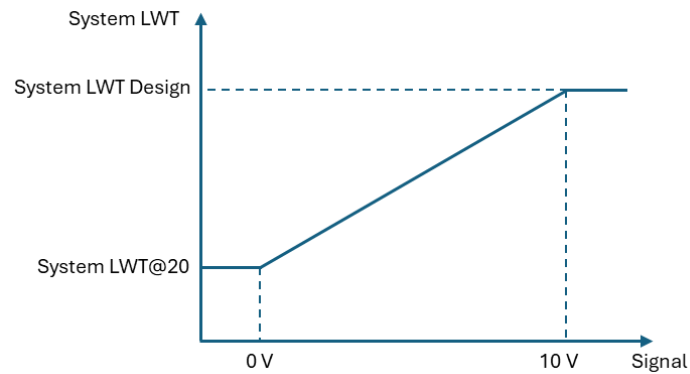


Figure 5-Boiler Setpoint via 0-10V signal

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 (Only EWYT-CZ and EWYE-CZ series)

Menu	Parameter	Default	Range	Description
[27] Bivalent Operation	[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/Siemens HMI at path:

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

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