

| General description:

Free Cooling is a ventilation system dedicated to the telecom BTS. Its purpose is to keep the container or room temperature at a desired level by providing cooler ambient air to the container or room interior. Such solution significantly reduces the energy consumption required to maintain the temperature inside the appropriate level.

The system is controlled by Pi1 control unit which according to actual climatic conditions:

- + controls Free Cooling fan (air flow regulation);
- + turn on and off air-conditioner.

| Application:

- + temperature regulation in BTS station.

| Features:

- + maintaining precise thermal parameters at a preset level with minimum energy consumption;
- + fluent regulation of injected air flow;
- + fully automatic and quiet operation;
- + cooperation with existing air-conditioner;
- + remote monitoring and control;
- + large surface pulse air filters;
- + insect filters for protection against insects;
- + sleeve filters (optional) - improving the temperature gradient in the room;
- + external assembly of the Freecooling Box – main system components doesn't take the place in the container;
- + power supplied by 48Vdc rated voltage – ventilation system works even during the AC mains failure;
- + high cooling capacity of the ventilation system at low energy consumption;
- + possibility to use the controller elements from the existing on-site power supply system with PI1 control unit;
- + fire-fighting functionalities - during a fire alarm, fan is turned off (optional).

| Design:

The standard version the Free Cooling system consists:

- + Freecooling Box –module with fan and cool air inlet;
- + Air extractor with a gravity air louver, which opens the ventilation duct, if outlet pressure is present (fan operation);
- + PI1 controller module - can be integrated into the Telzas power supply system or as a stand-alone device;
- + indoor temperature sensor;
- + ambient temperature sensor;
- + relay controlling the air conditioner operation.

Optionally the system can be equipped with additional modules:

- + electronic thermostat - during a critical failure the free cooling ventilation system, the control unit will not run air-conditioning system. Beyond a certain temperature threshold it will be turned on by electronic thermostat. If the container is not equipped with air conditioning system, then electronic thermostat will turn on the free cooling fan for maximum speed;
- + pressostat – which send to the controller information about the filter pulse dirtying. Using this feature, there is no need to periodically replace the pulse filter;
- + sleeve filters - can be applied when the cool air inlet is located at the top of the container and there is available space in the container. Thanks to sleeve filters a stream of cool intake air is spread over a larger area which improves the uniform distribution of temperature in the container.

| Principle of operation:

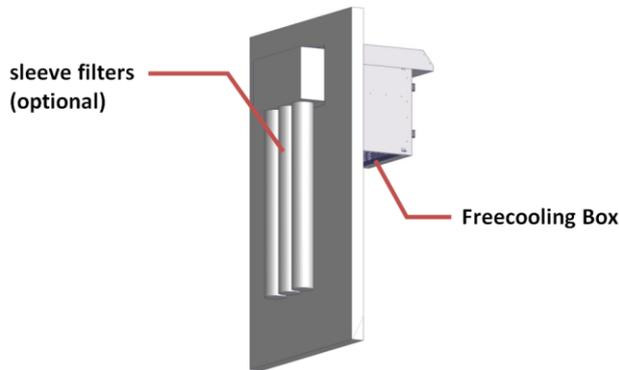
Free Cooling system operation is to keep the desired temperature inside the container on the basis of the PID algorithm realized by system controller. The basic task of this controller is to generate an appropriate signal to a regulated object (fan, air-conditioning system) to achieve desired temperature in shortest possible time at optimum energy consumption.

Regulation signal is the difference between the desired and the actual temperature inside the container. If the difference is positive regulator increases the fan speed, otherwise the fan speed will be decreased. Free cooling system allows to maintain precise room temperature and reduce OPEX by significant energy reduction related to classical approach: using only air-conditioning system.

| Benefits:

The OPEX savings are dynamical. Operation time of the air conditioner will depend on the outside temperature. For example for difference between internal and ambient temperature $\Delta t=5^{\circ}\text{C}$ (container $t=25^{\circ}\text{C}$, ambient $t=20^{\circ}\text{C}$) energy savings related to climate control in comparison with classic approach (air-conditioning system) will be ca. 72%.

In stable temperature system maintains fan speed at a low level, so energy consumed by the fan is modest.



Basic parameters:

General data:

External dimensions:	(H x W x D):	
Freecooling Box	mm	784 x 800 x 800
PI1 control unit		(1U)x (19") x 320mm
Freecooling Box enclosure material	-	aluminum or steel coated by powder or polyester paint
Cooling power	W	Depends on Δt

2,5kW fan parameters:

Nominal input voltage	V_{dc}	48
Range of input voltage	V_{dc}	36...57
Air flow	m ³ /h	~1130
rotational speed	r.p.m	2700
Input power	W	95
Input current	A_{dc}	2,2

5kW fan parameters:

Nominal input voltage	V_{dc}	48
Range of input voltage	V_{dc}	36...57
Air flow	m ³ /h	~2620
rotational speed	r.p.m	1930
Input power	W	208
Input current	A_{dc}	4,35

Filter parameters

Type	-	FS Purse filter
Filtration class	-	G4
Number of purses	pcs.	6
External dimensions (H x W x D)	mm	592 x 592 x 300
Active area	m ²	2,2

Functions of the PI1 control unit:

Basic functions:

- + measurement of two temperatures: internal and external;
- + smooth fan control depending on the temperatures – according to algorithm;
- + control of the Air-con operation by the additional relay placed in the power supply distribution panel, which is controlled by PI1 unit potential-free contacts;
- + send out alarms in the form of dry contacts (configuration logic alarm contacts (NO or NC) by the external software);
- + alarm visualization - LED;
- + configuration parameters of the controller by the external software
- + testing of relays and the fan by a button press.

Optional functions:

- + remote supervisory and monitoring - presentation and configuration system parameters by selected communications medium:
 - Ethernet,
 - fixed network (telecom modem),
 - mobile network (GSM/GPRS);
- + user interface with OLED color display – presentation and configuration system parameters;
- + events history;
- + 7 additional alarm outputs – potential-free relay contacts.

Alarms:

- + Power supply alarm/Control unit failure;
- + Fan Alarm;
- + Temperature Alarm 1 – excess of 1st temperature threshold (the time delay from 0 to 120 minutes);
- + Temperature Alarm 2 – excess of 2nd temperature threshold (the time delay from 0 to 120 minutes);
- + Door alarm – signalization of the free cooling box opening;
- + Alarm replacement filter - a signalization of dirty filter.

Possible configurations:

The Free Cooling system may operate in two different configurations:

- + **Free Cooling + Air-conditioner** - the ventilation system consists of a Free Cooling system and air-conditioner installed in a container. Control unit will start air-conditioner when the primary free cooling mechanisms will be not sufficient to keep desired temperature;
- + **only Free Cooling** - the ventilation system consists only of a Free Cooling system. In such a configuration may occur temporary excess of the critical temperature. It should be considered providing additional thermal insulation (eg. Batcooler battery cabinet) for components which should be surrounded by a special concern for high temperature (eg. batteries).