COOLING FAN SIZING

for thyristor cabinet

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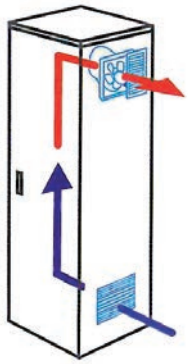
POWER LOSS IN THYRISTOR UNIT

All the thyristor unIts when are in conduction produces power loss that dissipate inside cabinet in term of heating.
Due to this fact the internal temperature of cabinet is higher than ambient temperature.
To be cooled the thyristor need of fresh air and to do it are normally used:

A) Fan mounted on all the front door (for low mass flow)

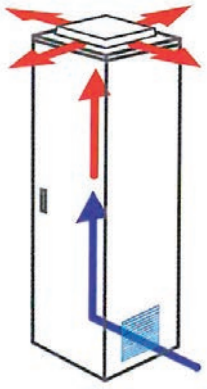
Forced Ventilation by Fans



This metod is used with low and medium dissipation inside the cabinet.
Fan Cooling is a fast method to dissipate the high temperature inside a cabinet generated by Thyristor unit.
The ventilating unit are constituted by Fan + Grill working in aspiration positioned in upper part of the cabinet where the hot air goes in roof direction because the fan mounted in Thyristor unit work in aspiration.
The fresh air come from the bottom of the door, this is the most economic system to reduce the temperature inside a cabinet.

B) Fan mounted on the roof of cabinet (for medium/high mass flow)

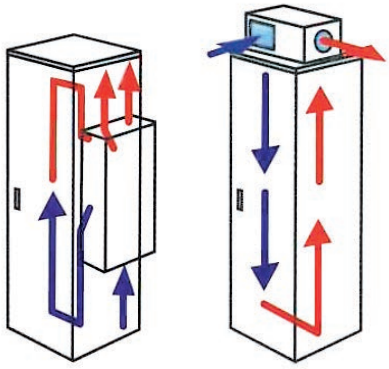
Cooling by fans extraction



This metod is used to remove medium high dissipation from the cabinet.
The roof exhaust fan unit are equipped with motor able to garantee big mass flow for cooling.
This is a fast method to disipate the high temperature inside a cabinet.
The ventilating unit are on the roof working in aspiration and able to remove the hot air that goes in roof direction because the fan mounted in Thyristor work in aspiration.
The fresh air come from the bottom of the door, this is the most economic system to reduce the temperature inside a cabinet.
But if the room, where cabinet is mounted is small and not conditioned, the ambient temperature can rise and in this case is necessary to provide an air conditioning as in below drawing.

B) Conditioner mounted on cabinet

Air conditioning



Air conditioning allows to have internal cabinet temperature lower than the external one.
And at same time to keep separate internal cabinet ambient by external one for pollution and agressive atmosfere.
So when the ambiet temperature is too high is necessary to use air conditioning

PROCEDURE TO SIZE FAN AIR MASS FLOW

Pay attention for the power loss in each Thyristor unit.
You can find power loss formula
POWER LOSS = THYRISTOR LOSS + FUSES LOSS (W)

Make the addition of power loss of the units mounted inside and use the formula:

$$V = f \times \frac{Qv}{tc - ta}$$

Qv = Total power losses (w)
ta = Ambient temperature outside Cabinet (°C)
tc = Temperature inside Cabinet (°C)
V = Fan air mass flow (m^3/h)
f = Altitude coefficient

ALTITUDE	f	ENG UNIT
0:100	3.1	m^3 k/Wh
100:250	3.2	m^3 k/Wh
250:500	3.3	m^3 k/Wh
500:750	3.4	m^3 k/Wh
750:1000	3.5	m^3 k/Wh

If you find a fan already mounted on cabinet and you want to verify the aspected temperature inside:

Read the mass flow on fan and apply the formula

$$tc = \frac{f \times Qv + Vta}{V \text{ (mounted fan on door)}}$$

Remember that the nominal current of Thyristor unit is referred to 40°C temperature inside cabinet tc.

If you reach an higer temperature > 40°C you have to derate the nominal current of the unit (see page 6).
Anyway you suggest to work at 50°C Max to garantee a long life and reliability of the electronic equipment.

FAN VENTILATION

Just to have an idea of the fan ventilation see the below examples.

EXAMPLE 1

Target: Define necessary Fan Mass Flow for a cabinet where inside is mounted a Custom Unit with control on two phase of a 3 phase resistive load.

Code: C2 1100-72AB0H2023
Power dissipation (Thyristor + fuses) see page 7:
1100 x 1,3 x 2 = 2860

$$V = f \times \frac{Qv}{Tc - Ta} = \frac{3{,}1 \times 2860}{50 - 40} = 886\ m^3/h$$

This means that to respect the delta in temperature has to be used a fan of 900 m^3/h

EXAMPLE 2

Target: Define necessary Fan Mass Flow for a cabinet where inside is mounted a Custom Unit with control on two phase suitable to drive a 3 Phase Resistive Load.

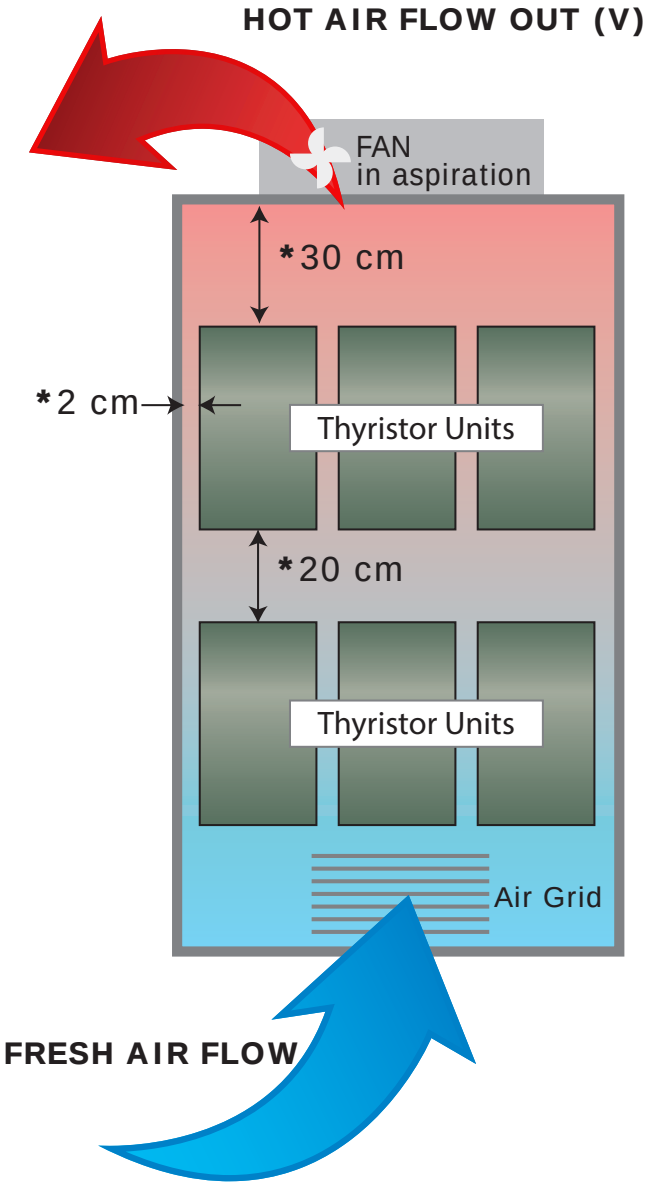
Code: C2 0300-72AB0H2023
Power dissipation (Thyristor + fuses):
300 x 1,3 x 2 = 780 m^3/h

$$V = f \times \frac{Qv}{Tc - Ta} = \frac{3{,}1 \times 780}{50 - 40} = 241\ m^3/h$$

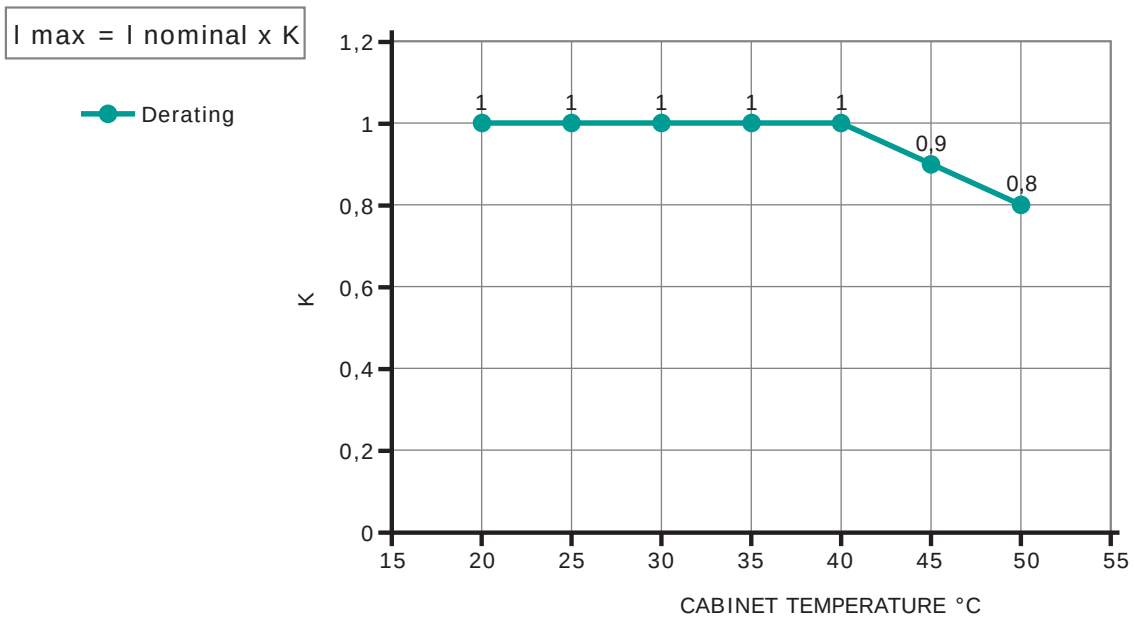
This means that to respect the delta in temperature has to be used a fan of 250 m^3/h

INSTALLATION

The Thyristor unit must be always mounted in vertical position to improve air cooling on heat-sink.
Maintain the minimum distances in vertical and in horizontal as represented, this area must be free from obstacle (wire, copper bar, plastic channel).
When more unit has mounted inside the cabinet maintain the air circulation like represented in figure without obstacle for the air flow.
Is necessary to install a fan to have better air circulation as calculated previously.



CURRENT DERATING AS FUNCTION OF CABINET TEMPERATURE



When cabinet temperature exceeds 40°C the nominal current of the Thyristor units has to be derated in line with above graph.

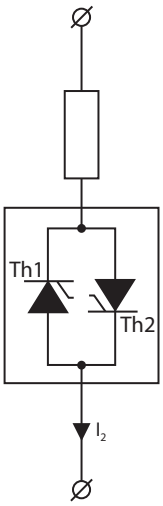
EXAMPLE

Thyristor unit with nominal current 100A at 40°C become at 50°C cabinet temperature:

Imax = I nominal current (40°C) x K
Imax = 100 x 0,8 = 80A

This allows that the junction temperature of the Thyristor remain the same despite the cabinet temperature at 50°C. This is possible just reducing the current flowing inside the Thyristor.

POWER DISSIPATION OF THYRISTOR UNITS



Power dissipation in Thyristor Unit is given by Semiconductor Fuses and Thyristor Th1 & Th2

Formula to calculate Power dissipation is given by:

Pd = Load Current x 1,3 x Number of Phases (W)

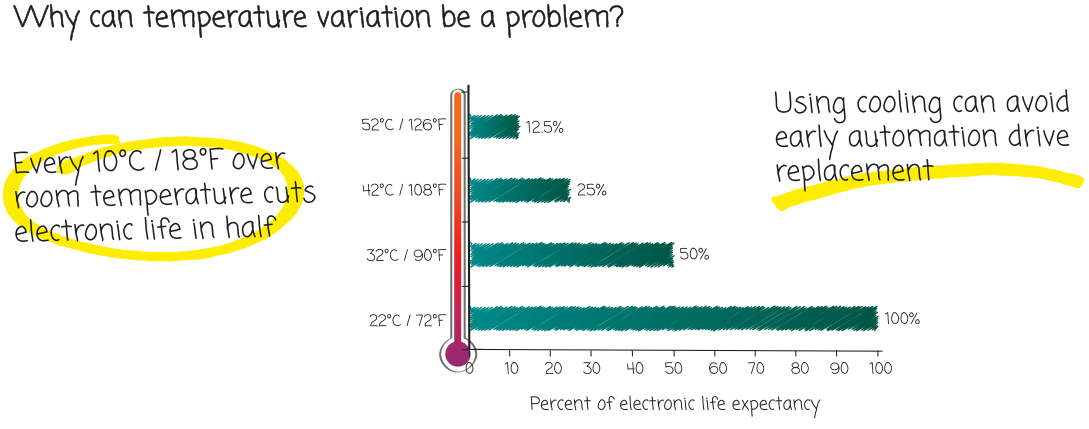
Number of phases: 2 for Two Phase Unit
3 for Three Phase Unit

Inside a cabinet there are many Thyristor units.
It's necessary to do the above calculation for each Thyristor unit and finally to do the sum.

TEMPERATURE INSIDE CABINET

It's vital to remain with temperature inside the cabinet in limit fixed by specification. That is 40°C
If temperature excede 40°C it's necessary a derating of the current unit. See page 6.

Life of an electronic device as a function of temperature



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