Technical collection

Canalis® busbar trunking systems in electronics factories

Technical application specifications

Schneider Electric

Contents

Introduction

Field of investigation / Definitions

The field of investigation for the present document is the factories that manufacture active components.

- **Factories that manufacture active components (integrated circuits, microprocessors, etc.)** are units that design, manufacture and produce electronic components. They are fitted out with clean rooms and in certain cases have assembly and testing lines.

Factories that manufacture active components have special conditions that apply to them concerning their infrastructure as well as on an electrical distribution level. That is why these technical application specifications are dedicated to them.

At least two other types of electronics factories can be determined:

- **Electronic board assembly and circuitry factories:** they correspond to units that manufacture electronic boards by assembling components on printed circuits. They are fitted out with component assembly tools using traditional welding techniques or the CMS method (components mounted on the surface), and automatic or manual testing benches.

- **Testing units for semi-finished and finished products:** they correspond to units that test boards and electronic components before they are commercialised.

The electrical distribution concept for assembly factories and testing units is virtually identical and resembles that of manufacturing plants. Consequently, this type of factory is dealt with in another technical application specifications manual.

General

General information

The particularity of an electronics factory is to have rooms with a limited pollution level. That is to say, only a certain number of particles is authorised: 0.5 µm per foot^3 (0.028 m^3). It varies in function of the process and the type of manufacture.

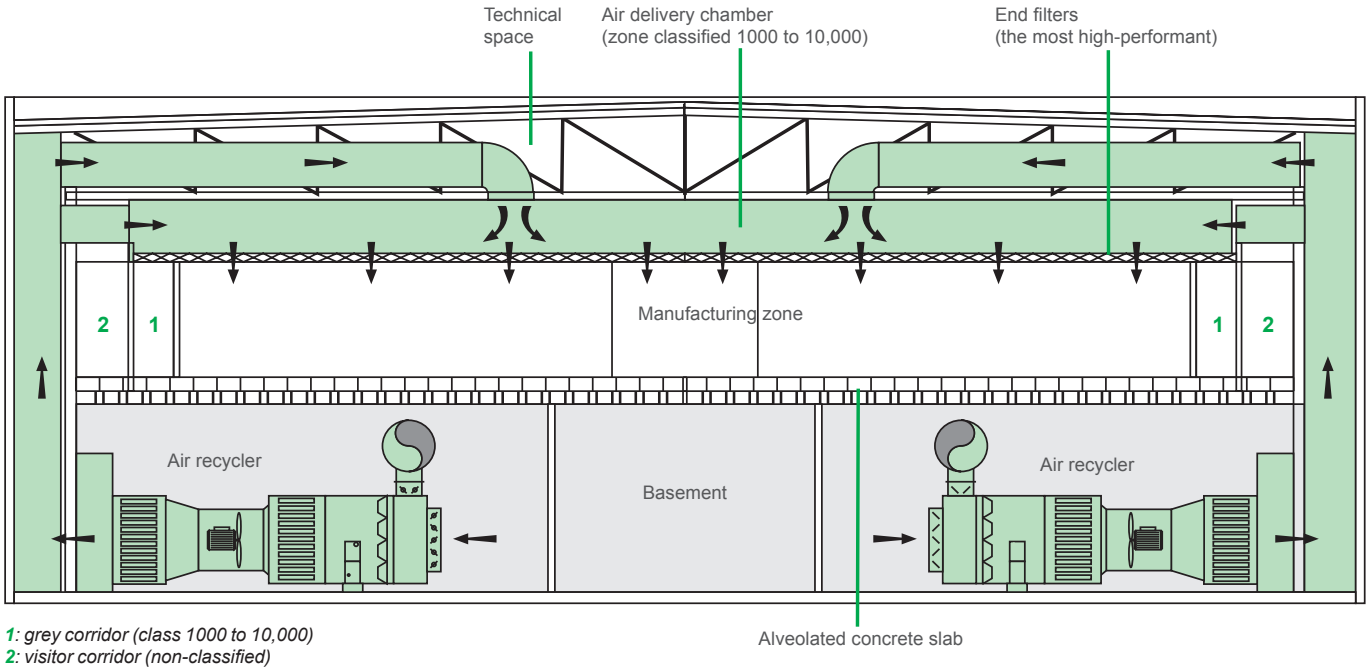
This pollution level is defined by classes. It has been assessed by the Federal Standard 209F. It deals with classes: 1, 10, 100, 1000, 10,000 and 100,000.

Note:
- The air in a non-filtered room contains 1 to 10 million polluting particles per foot^3.
- A class 1 room only authorises one polluting particle per foot^3. This is the best class.

Rooms that require a pollution level between 1 and 100 particles per foot^3 are called "clean rooms". Rooms with higher classes (1000 and more) are called "grey".

Clean rooms are usually reserved for the front side of machines (where components are handled); whereas grey rooms deal with less sensitive machine zones (motors, etc.).

Cross-sectional view of a manufacturing building



1: grey corridor (class 1000 to 10,000)
2: visitor corridor (non-classified)

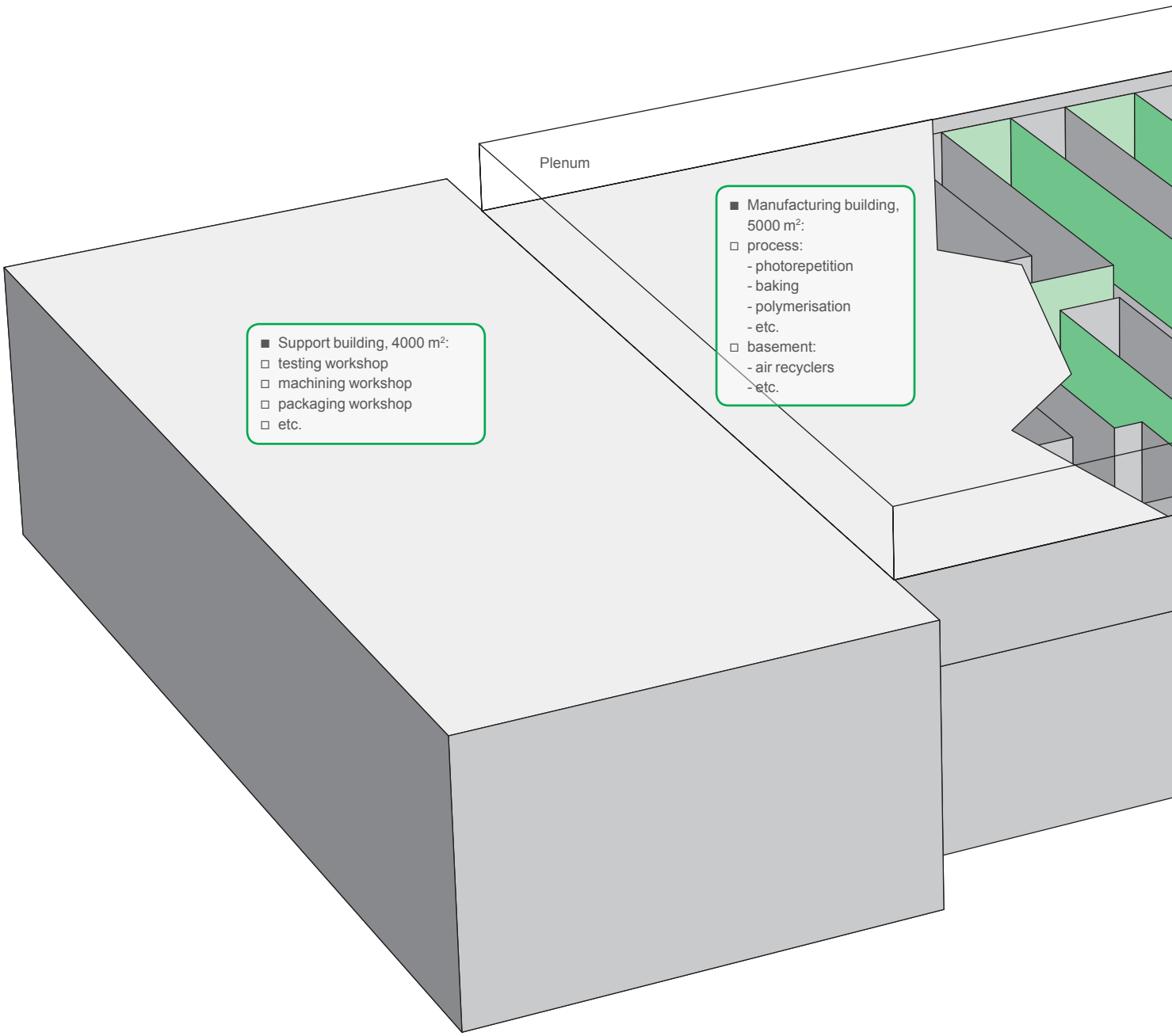
Ground equipment: this corresponds to all the equipment which contribute to obtaining a class. To obtain a class 10 rating, the volume of air in the clean room must be renewed every 6 to 8 seconds. This means that the room is fitted out with air treatment and recycling units and stagnant air exhausters. A class 10 rating also implies a certain degree of hygrometry (25% to 40%) and a certain temperature (23°C ± 1°C). Boilers and refrigerating sets are therefore essential as well. Maintaining the environment in a clean room is what costs the most in energy and in m^2 of occupied space (clean rooms can consume up to 70% of the total electrical energy supply).

Plenum: this corresponds to the air delivery chamber. It has a class 1000 to 10,000 rating. The area located above the clean room is called the air delivery chamber and the area below is called the air discharge chamber.

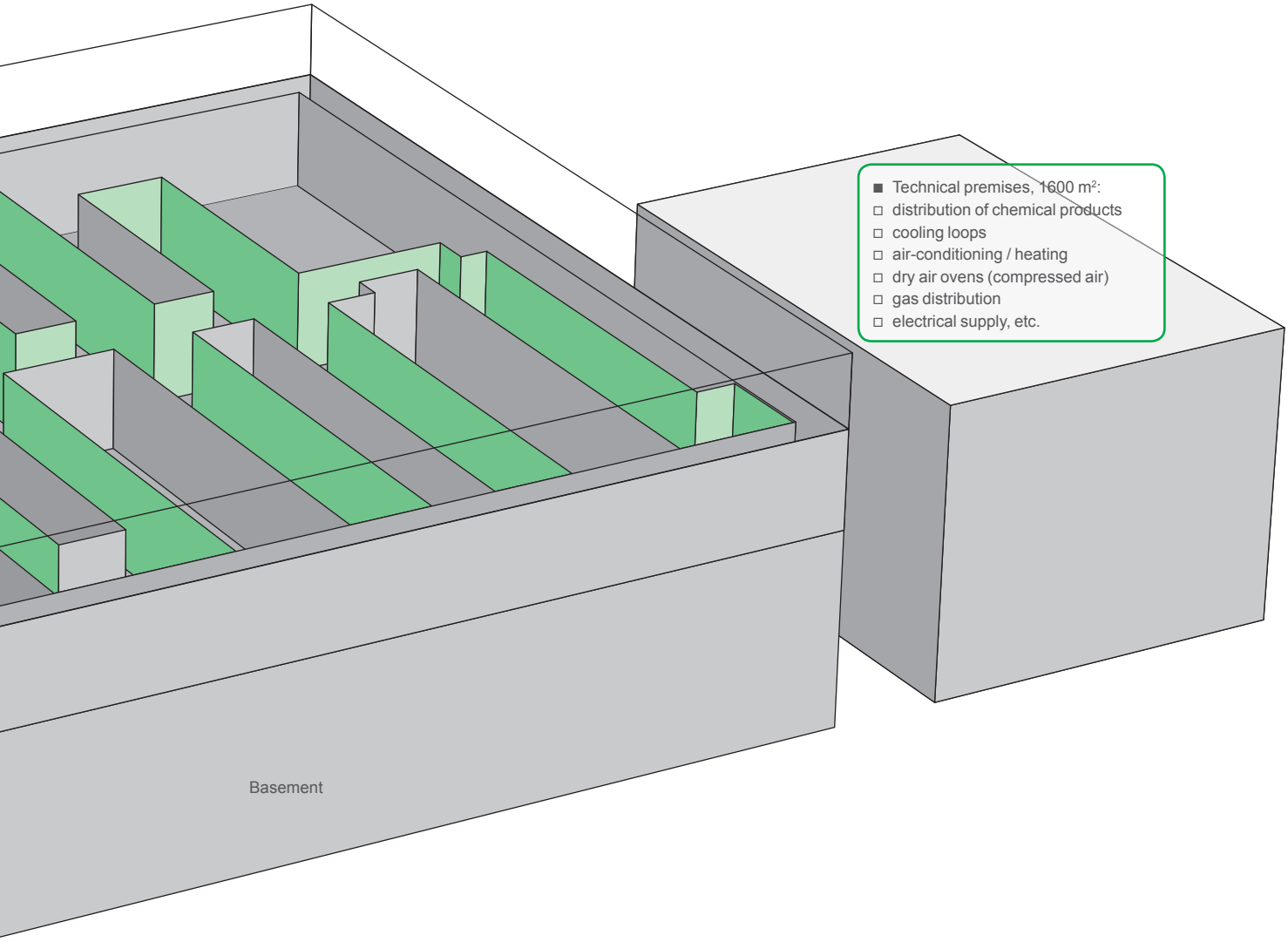
Basement: this corresponds to the gallery where part of the ground equipment is located as well as all that is needed to operate the machines located in the clean room (electrical cabinets, pneumatics, etc.). In general, it is located under the clean room's technical floor.

General

Overview



General



Clean rooms and clean corridors

Grey rooms and grey corridors

Final customer needs

General needs

Operating continuity:

In this type of factory, every production interruption (even just a few minutes) leads to:
- ■ Financial losses that can add up to millions of Francs. They are caused by:
  - □ the cooling down of ovens: all parts manufactured below a certain temperature threshold are discarded,
  - □ the hardening of certain products: the drying of the resin causes it to set on equipment, several hours are needed for cleaning,
  - □ pollution of the air due to the interruption of recyclers: parts in the process of being manufactured are irreversibly damaged.
- ■ Danger of persons:
  - □ the presence of very toxic chemical products makes permanent air cleansing mandatory.

Evolution:

The field of electronics is constantly evolving. Manufactured products therefore have a short life span, around 2 to 3 years. Consequently, the entire production tool must be replaced on a regular basis. In general, the site is kept, however the entire platform's architecture upon which the clean rooms lie, is modified.
The possibility of completely recovering and reusing Canalis products is a considerable financial advantage.

Needs concerning the electrical installation and the appropriateness of busbar trunking system solutions

In the installation:

The less space used means all the less air to be treated so as to obtain a certain environment. Consequently, the compactness of the busbar trunking system is an important plus.
Moreover, the technical galleries, spaces and basements are more and more overburdened with all sorts of pipework and equipment auxiliaries. The decentralized distribution solution by Canalis thus provides a new advantage: the number of sub-distribution cabinets, thus the covered floor space, is optimised.

During operation:

The most important element for the operator is the continuity of supply of the electrical distribution. It is absolutely necessary to avoid production interruptions which are synonymous with financial losses and endangering the health of persons:
- ■ Protection using a circuit breaker enables fast resetting in the case of a break and enables discrimination, thus the continuity of supply.
  The consistency of Schneider's decentralized distribution system (distribution using the busbar trunking system and protection using circuit breakers) entirely satisfies the need for continuity of supply and provides:
  - □ simplicity of choices,
  - □ consistency of solutions,
  - □ rationalisation of components,
  - □ a manufacturer guarantee of the system's co-ordination.

As with any manufacturing plant, production interruptions, even when programmed, are very costly. However, site equipment is acquired progressively and corresponds to a rise in the production rate: new machines are installed on a regular basis.

The design behind decentralized electrical distribution facilitates this machine base evolution and minimises the installation time for new receivers.

Maintenance teams need to verify connections on a regular basis. This operation requires the deenergisation of sub-division cabinets. For decentralised distribution, maintenance is conducted outgoer by outgoer and production is therefore not penalised.

Final customer needs

The power needs of clean rooms

Ground equipment:

Each kW used in the process implies one kW to be evacuated. Consequently, ground equipment is the greatest energy consumer (60 to 70% of total installed power).

Air recycler:
It corresponds to a complete unit that includes:
- a fresh air / recycled air mixer,
- a pre-filtration level,
- a hot / cold level (maintaining the temperature depends on external climatic conditions),
- a humidifier (maintains the degree of hydrometry),
- acoustic traps (sound elimination),
- a fan (propulses the air towards the clean room).

Ratios:
The power needed depends on the surface area, the class and type of production. Consequently, it is determined on a case by case basis.

Example of a 1400 m², class 10 type clean room:
Equipment needed:
- 12 recyclers,
- 2 refrigerating sets,
- 2 fresh air units (including one back-up),
- 1 air exhauster.

e.g. a total of 1800 kW, which corresponds to 1.3 kW/m².

The examples converge towards this type of ratio:

Ratios: 1 kW/m² < P installed < 2 kW/m²

Manufacture:

Depending on the stage of manufacturing, power for receivers is very different:
- from 100 to 170 kVA (ovens)
- from 10 to 100 kVA (element implanting machines)

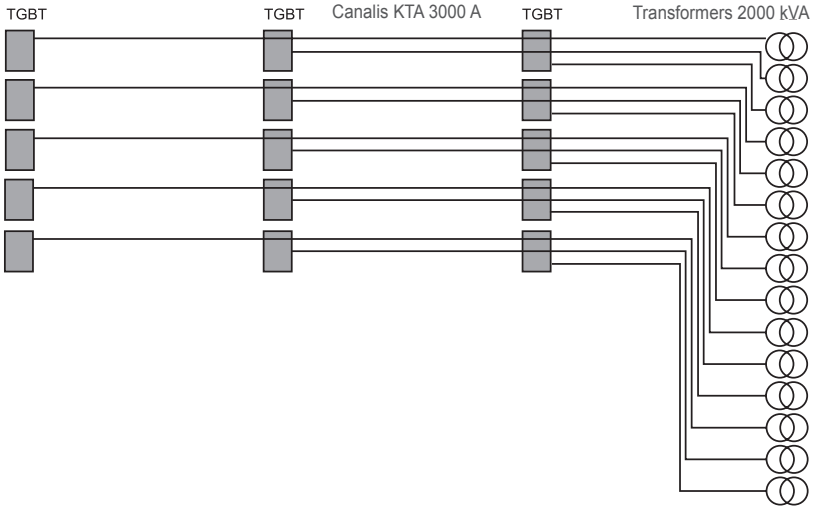
Ratios: P installed < 2 kW/m²

Supply of the manufacturing building

For a building like the one described on page 5, installed power is near 30,000 kVA (representative value for all the factories of this type).

Consequently, the number of transformers needed to supply an active component manufacturing plant is always very significant.

Example of the factory presented on page 5:
15 transformers (2000 kVA) are needed to supply:
- manufacturing procedures for fluids that are useful for the process,
- procedures to obtain the specific environment for clean rooms,
- clean room machines (ovens, photographic systems, etc.),
- the product test and packaging building.



Taking into account the currents involved, it suffices to link the transformers to the Canalis KTA switchboards. This compact range has numerous advantages:

1 - Worry-free implementation:

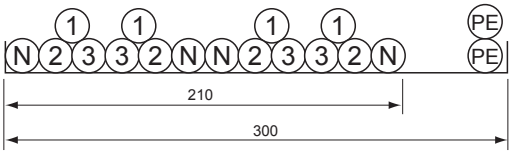
Determining permissible currents in several conductors in parallel implies that currents are distributed in a uniform fashion. This means that:
- the impedance of each conductor is identical
- the lay-out of the conductors of the different phases is as symmetrical as possible.

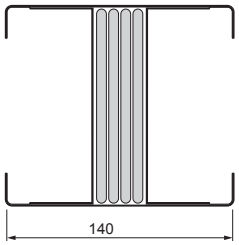
In case these conditions are not satisfied, the circuit may be subjected to abnormal overheating.
But the balance of currents is, in theory, only possible with 2 or 4 conductors in parallel. Above this number, unbalance becomes significant and is difficult to evaluate.

Resorting to busbar trunking systems is thus necessary to carry strong current (Canalis KTA from 1000 to 4000 A).

2 - Reduced dimensions:

Example of a link between a transformer 1000 kVA and an MSB.
It can be done:
- **using a busbar trunking system:**
  - Canalis KTA 1600 A.
- **using cables:**
  - phase: 4 x 240 mm² aluminium
  - neutral: 4 x 240 mm² aluminium
  - PE: 5 x 240 mm² aluminium.





Note:
Using Canalis, directional changes are done using right angles, without a bending radius.

The conventional solution uses at least 3 times as much space.

3 - Great safety:

- **Fire barrier and non-propagation of fire:**

Canalis busbar trunkings have built-in fire barriers: in case of a fire, the minimum withstand is 2 hours as in ISO 834.
They can be used in safety circuits, when they are installed in a fire enclosure (90 minute withstand as in DIN 4102 - 12) which guarantees continuity of supply.
Insulating materials are self-extinguishing (incandescent wire test as in IEC 695.2.1).
Furthermore, Canalis KT has a very weak calorific value: this guarantees the non-supply of a possible fire.

- **Protection in the case of a fire:**

Natural vectors in the case of a fire, cables strongly contribute to the production of smoke. Indeed, cable ducts contain halogens, which through self-consumption, release opaque, toxic and corrosive smoke:
- the opacity of smoke limits visibility, renders escape more difficult and produces panic,
- toxic gas slows down reaction capacities and causes suffocation,
- the hydrochloric acid contained in these vapors, attacks all types of metals and corrodes them, even after smoke has disappeared.

All insulating materials used in KT busbar trunking are halogen free. In the case of a fire, toxic gases (IEC 754) and opaque smoke (IEC 1034) will not propagate.

Electrical distribution

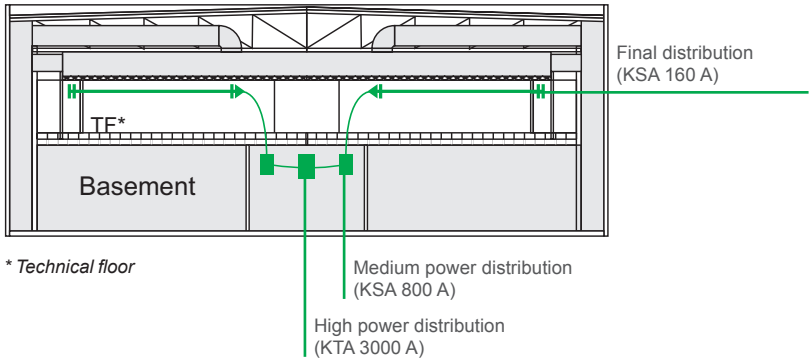
Electrical distribution of the manufacturing building

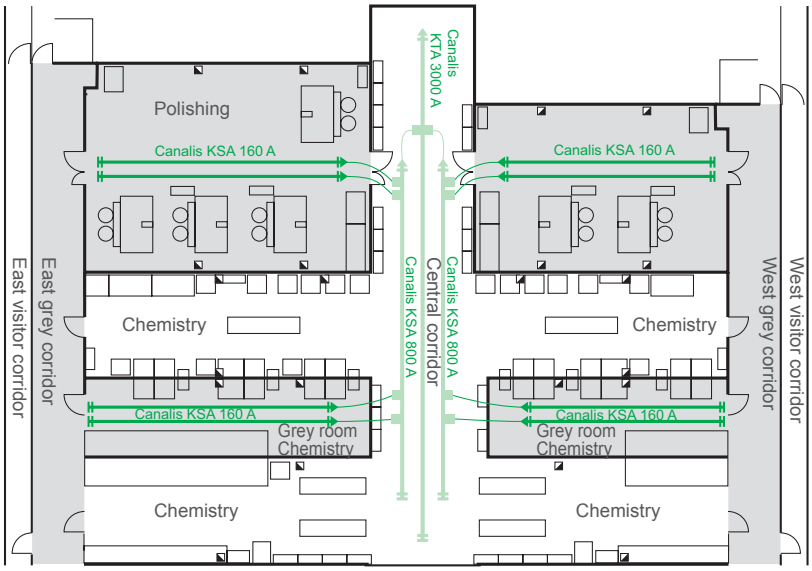
In clean rooms, the power of receivers is weak compared to that of ground equipment. However, the number and density of tap-off points, as well as the necessity to be able to intervene while energised, naturally imply the use of a busbar trunking system.
In clean rooms, everything is smooth so as to limit air movement (walls are lacquered): fluids are located in the grey rooms and/or in the basement.
Thus, whatever the building's architecture may be, the busbar trunking system that supplies equipment located in the clean rooms is installed in the grey rooms (operating and maintenance personnel have access to the grey room).

The architecture for electrical distribution depends on the building's construction:

Fishbone electrical distribution:

- In recent factories, the basement is directly built under the technical floor. Ground equipment is layed-out around the central building and represents a significant surface area (1 m^2 of clean room requires 4 to 7 m^2 of ground equipment).

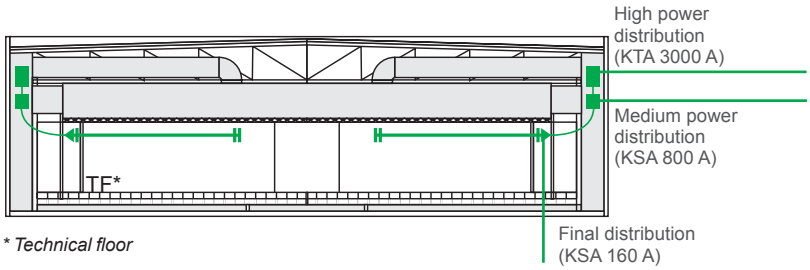




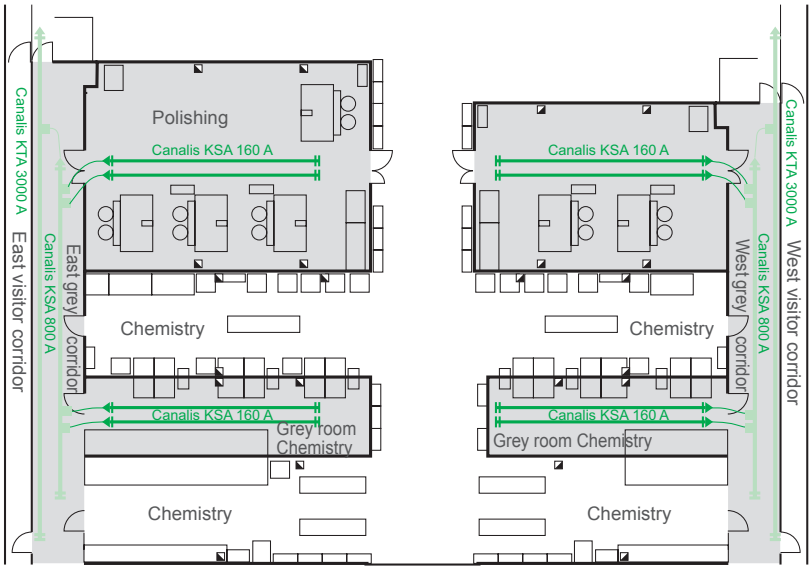
Electrical distribution

Comb electrical distribution:

- In older factories, the technical gallery is located above the technical floor. Part of the ground equipment is therefore located on the building's roof. It thus takes advantage of surrounding air for fresh air intake.



** Technical floor*



Advantages of the busbar trunking system:

Technological progress in the field of electronics is such that factories must be recycled so as to adapt to new generation component manufacturing: partitions are torn down; only a large empty space remains. For this reason, the use of BTS is completely justified: main busbar trunkings remain in place whereas secondary busbar trunkings are dismantled, moved and reinstalled.

Production modifications lead therefore to **mobility**:

- of secondary lines that are moved along with the grey rooms,
- of tap-off outlets the location of which depends on the implantation of new machines.

References

Canalis in electronics factories

Country	Company
France	Motorola
	Storagetek
	Bosch
	Philips
	Thomson CSF
	Thomson
	Thomson
	Bull
	IBM
	Hewlett Packard
	Ericsson
Singapore	Compaq Asia
	Apple Computer
	Siemens Component
	SGS Thomson
	Olivetti
	Amd International
Ireland	Intel
Brazil	Philips
	Motorola
Corea	Samsung Electronic
Italy	Olivetti
Hong Kong	Motorola
Sweden	Ericsson

Note: *non-exhaustive list*

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