

USER MANUAL
2025

WAVE USER MANUAL



IC570MAX & IC590MAX

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<i>Ensure that anyone operating the machine has thoroughly read and comprehended the entire operating manual.</i>	

Introduction - Purpose of the Machine

The freeze dryer is specifically engineered for extracting solid and liquid substances that do not release toxic or explosive gases or liquids. It is not intended for drying wastewater or sewage, as this could damage the surface cables and vacuum pump in a short period. Please refrain from introducing solvents. The primary application of the freeze dryer is for drying food and plants, with a particular emphasis on water extraction.

Guarantee and liability

Please refer to the delivery conditions for information regarding our guarantee and liability, which were provided prior to your purchase.

Please note that our guarantee and liability will not apply under the following circumstances:

1. Incorrect usage of the machine.
2. Failure to adhere to the instructions in the operating manual.
3. Incorrect installation, use, or maintenance.

We do not assume any liability or provide a guarantee for the machine's performance. The outcome of the freeze-drying process is typically determined by the specific material being processed, as it is often a natural substance influenced by various factors. Therefore, several tests are necessary before achieving a satisfactory result.

For precise details about the guarantee and service level, please consult the sales contract and/or the invoice you received upon purchasing the machine.

Understanding Freeze-Drying

The primary components of the freeze dryer comprise the vacuum chamber, vacuum pump, and cooling system.

The freeze-drying procedure involves several key steps, starting with a cooling phase during which the materials are chilled to approximately 10°C below the solidification point of the specific goods (which varies depending on the product). We recommend pre-freezing your materials in a separate freezing device, such as a standard freezer or a shock freezer. While freezing within the freeze dryer is possible, it is not energy-efficient and takes longer than using a regular freezer.

Once your material has reached the desired temperature, the vacuum pump is activated, creating a vacuum within the chamber containing the materials to be dried. If you've pre-frozen your materials separately, we advise freezing them directly on the machine's trays, promptly loading them into the freeze dryer, and initiating the vacuum. At this point, you can select your program and start the process.

The sublimation process commences with the application of heat through heating mats located beneath the drawers. This heat transforms the water within the materials into water vapor. Since

the walls of the vacuum chamber are colder, the water vapor migrates there and freezes on the wall. As needed, you can perform multiple drying phases. The duration of the drying cycle is heavily dependent on the material to be dried and the vacuum level.

Freeze-drying, also known as lyophilization, is a promising preservation method. It begins by freezing the product, then reducing the pressure to remove the ice through sublimation, the process of transitioning from a solid to a gaseous state without first becoming a liquid. Unlike other preservation methods that evaporate water through heat, freeze-drying eliminates water in the form of ice.

It's crucial to ensure throughout the process that only the ice transforms into vapor, and not the water. Otherwise, your material could become overcooked, significantly altering its taste and appearance.

The low temperatures involved result in a higher-quality end product. Not only does the product maintain its original shape, but the process is also gentle on vitamins. This is why freeze-drying finds extensive use in biomedicine and food processing, where nutrients and active ingredients are particularly well-preserved.

[History of Freeze-Drying](#)

The Pioneering Stages

The genesis of freeze-drying unfolded independently in the early communities of the Americas, East Asia, and Northern Europe. In the heart of the Andes Mountains, Peruvian tribes were already experimenting with freezing tubers and potatoes amidst the frigid peaks. They ingeniously harnessed the power of the sun to thaw these frozen provisions, allowing the ice to transform into vapor. This ingenious process yielded a traditional staple food that laid the foundation for a diverse array of meals. Consequently, indigenous peoples could ensure a year-round supply of preserved and delectable sustenance. The Peruvians, with their mastery of potatoes, the Japanese monks and their expertise in freeze-drying tofu, and the resourceful Vikings who applied this knowledge to cod preservation all reaped the benefits of freeze-drying.

Historical Landmarks

In a significant leap forward, 1890 marked the first instance where tissues were freeze-dried to perfection in a laboratory and subsequently rehydrated. Over the ensuing decades, freeze-drying underwent comprehensive research and was successfully scaled up. During the crucible of the Second World War, freeze-drying played a pivotal role in safely preserving and transporting vital resources, such as blood plasma. In subsequent years, this innovative technique was also harnessed for the secure transportation of vaccines. Notably, nearly all the food supplies for NASA's Apollo missions were effectively preserved through freeze-drying techniques, marking a milestone in space exploration.

Phases of Freeze-Drying

Freezing: A Vital Step

To prepare the product for freeze-drying, various freezing methods are possible. You can choose to employ a cold bath with liquid nitrogen, a shock freezer, a standard household freezer, or simply place the product on a shelf inside the freeze dryer. Ensuring the material is cooled below its eutectic temperature is crucial to prevent thawing and promote sublimation, preserving the product's original shape. Typically, most materials perform well when frozen below -22°C.

It's noteworthy that large ice crystals formed during slow freezing are the most conducive for the freeze dryer's drying process. Nevertheless, excessively large crystals can disrupt the cell structure of the product, leading to a lower-quality final product. To circumvent this, the freezing process should be expedited.

The Phases of Freeze-Drying

The second phase of freeze-drying, known as primary drying or sublimation, involves creating a vacuum by lowering the pressure and applying heat to the product, allowing the water to sublime. The vacuum encourages sublimation, while the condenser serves as a surface for the water vapor to solidify into ice. In the case of WAVE freeze dryers, the vacuum chamber wall functions as the condenser, safeguarding the vacuum pump from water vapor. It's important to add heat gradually to prevent structural and shape alterations in the material, as excess heat can cause the ice to melt and compromise the product's integrity.

This is succeeded by further phases of freeze-drying, referred to as secondary drying or adsorption, where water molecules that are ionically bonded are removed. By incrementally increasing the temperature compared to the primary drying phase, the bonds between the material and water molecules are broken. These drying stages can be adjusted flexibly, typically in 5°C to 10°C intervals, using the Siemens control system in WAVE freeze dryers. The resulting freeze-dried materials retain a porous structure. After the completion of the freeze-drying process, the vacuum can be released, and the material can be sealed airtight. Thanks to this meticulous process, most materials can achieve a residual moisture content of 1-5%.

Advantages of Freeze-Drying

- Treated products retain their original shape and structure.
- Aromas are better preserved than with other drying processes.
- Better taste and consistency for food.
- A gentle process that retains vitamins, nutrients, and active ingredients well.
- Less weight despite maintaining the original structure.
- Products can be rehydrated.
- Reduced risk of mold during the drying process.
- Very fast drying process.
- Freeze drying effectively eliminates nearly all germs and bacteria during the process.
- The material can be stored for up to 20 years.

Applications of Freeze-Drying

Freeze-drying is predominantly employed in pharmaceutical science to enhance the longevity of vital items, including vaccines and injectables. By eliminating water content and sealing the product in vials, it becomes conveniently storable, transportable, and easily reconstituted to its original state for injection.

In the realm of food preservation, freeze-drying plays a transformative role by rendering products lightweight while preserving their quality. Its ascent to popularity was further catalyzed when freeze-dried ice cream was developed as a snack for NASA astronauts. More recently, as the cost of freeze-drying has diminished, a diverse array of innovative products has emerged.

This innovative process breathes new life into items that may have been challenging to market otherwise, such as misshapen asparagus, which can be repurposed into innovative creations like asparagus powder for the food industry. Farmers seize the opportunity to process surplus vegetables and fruits, offering freeze-dried strawberries or apricots, among other delights. Confectioners also elevate their confections with the inclusion of freeze-dried ingredients.

In essence, freeze-drying opens doors to a multitude of creative possibilities, enriching the spectrum of products and experiences available to us.



The original freeze-dried ice cream created by Whirlpool Corporation for NASA, though it never had the chance to journey to space.

Time, Energy Consumption and Interesting Facts

The freeze-drying duration is a critical factor in making the most of a freeze dryer. Nonetheless, this time frame can significantly differ across various materials due to variations in water content, which stands as the primary influencing factor. Beyond this, there are other contributing factors to consider. For instance, fruits like oranges and tangerines are equipped with exceptionally water-resistant skins that store moisture efficiently. In such cases, the technique of cutting the fruit into smaller pieces becomes pivotal, as it expedites the freeze-drying process. Berries with thicker skins, like blueberries, are similarly adept at retaining water. On the other hand, strawberries prove to be notably easy to freeze dry.

The table below outlines the drying times for medium-sized pieces, approximately 10 mm in size, at final temperatures of 25°C, 40°C, and 60°C. It's worth noting that higher temperatures accelerate the drying process, but this may come at the expense of diminished vitamin retention and structural integrity. Therefore, it's imperative to customize temperature and drying cycles individually to achieve the desired quality of the end product. This adaptability is made possible through the user-friendly interface of the Wave freeze dryers.

There is a physical need of energy for the process of transforming ice in the material into vapour and then to condensate it again into ice in the coldtrap. This process needs approximately 0,96 kWh / kg of water. However even the best machinery on the market cannot accomplish the process with this low amount of energy. The 570/590 can perform this with 2.2 to 2.7 kWh/kg of water extracted which is significantly less than most other machines on the market.

The main reason for this low energy footprint is the use of the 2 alternating coldtraps that only need to hold on to a small amount of ice compared with the whole extracted ice capacity in most other machines as well the reuse of the heat from the compressors for the defrosting of the coldtraps.

Freeze-drying time in hours at different maximum heating temperatures

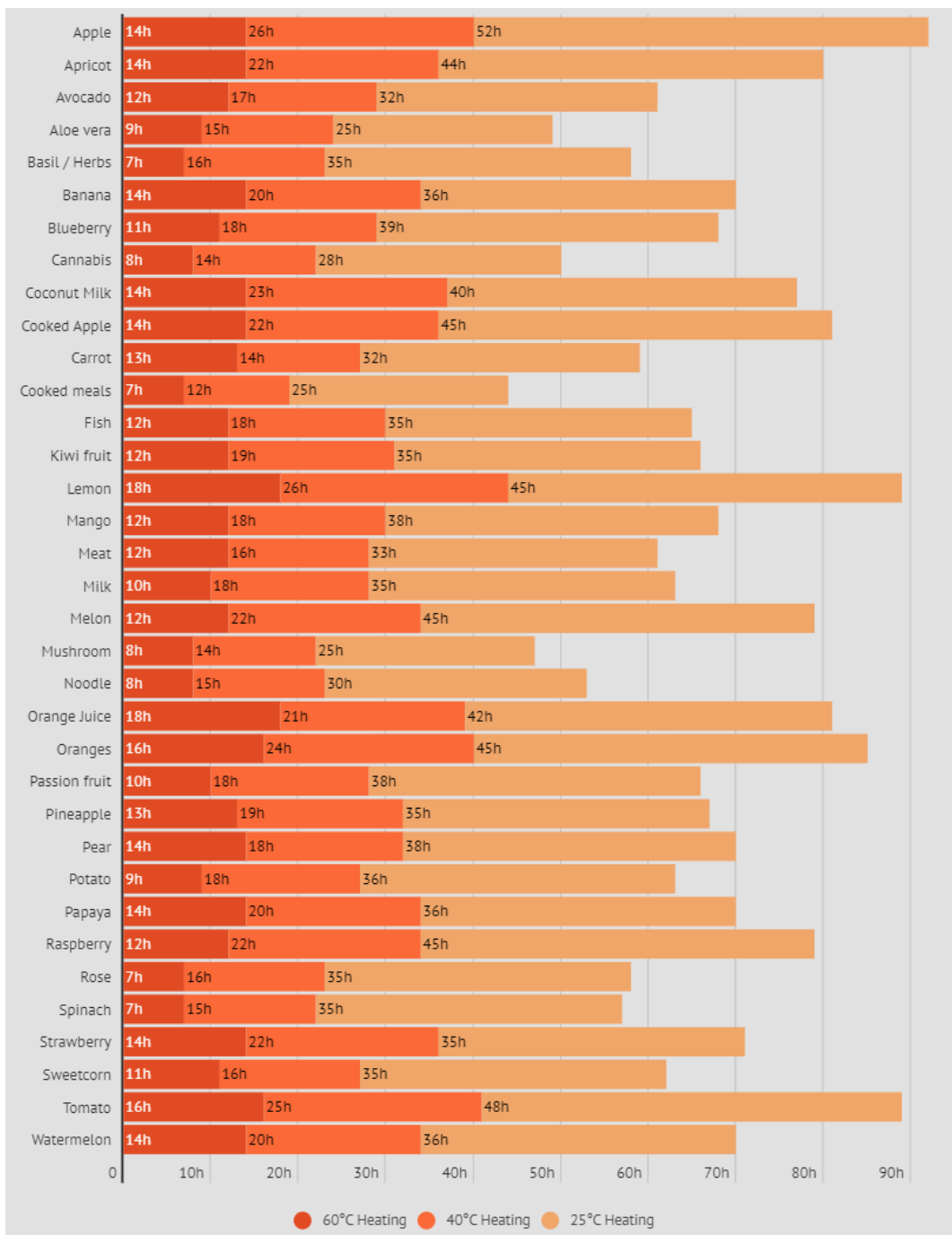
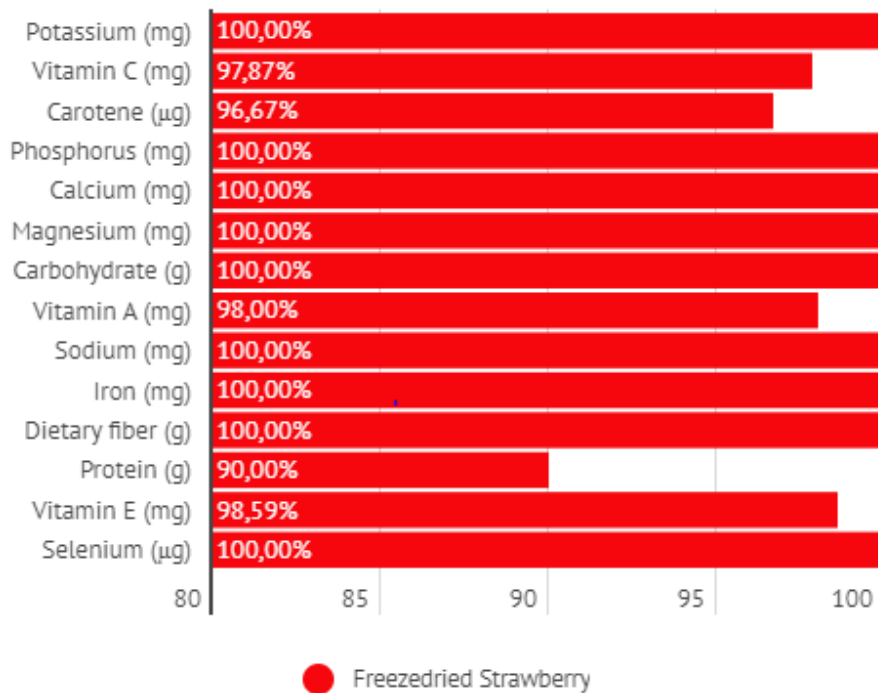


Figure 1; Source: <https://wave.cc/know-how>

Figure 1 below provides a visual representation of freeze-drying times in hours at various maximum heating temperatures.

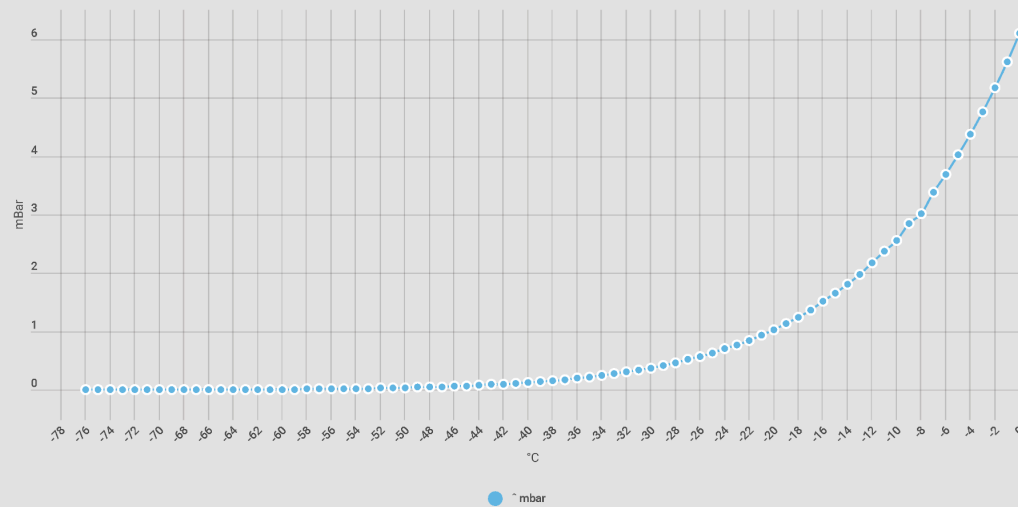
Nutrients before and after freeze-drying



Nutrient Name	Fresh Strawberry	Freeze-dried Strawberry	in %
Potassium (mg)	131,00	131,00	100,00%
Vitamin C (mg)	47,00	46,00	97,87%
Carotene (µg)	30,00	29,00	96,67%
Phosphorus (mg)	27,00	27,00	100,00%
Calcium (mg)	18,00	18,00	100,00%
Magnesium (mg)	12,00	12,00	100,00%
Carbohydrate (g)	7,10	7,10	100,00%
Vitamin A (mg)	5,00	4,90	98,00%
Sodium (mg)	4,20	4,20	100,00%
Iron (mg)	1,80	1,80	100,00%
Dietary fiber (g)	1,10	1,10	100,00%
Protein (g)	1,00	0,90	90,00%
Vitamin E (mg)	0,71	0,70	98,59%
Selenium (µg)	0,70	0,70	100,00%

Figure 2; Source: <https://wave.cc/know-how>

Ice Pressure - Curve (evaporation temperature)



[Download data](#)

Made with **Infogram**

The ice pressure curve serves as a vital reference point for discerning the temperature at which water will transition into vapor under a designated pressure. This knowledge is instrumental in comprehending the intricate nuances of the drying process and in crafting a tailored drying program that aligns seamlessly with your specific material.

Ice pressure curve as a table

Temperature (°C)	Vacuum (mbar)	Vacuum (mTorr)
-76	0.0010	0.75
-75	0.0012	0.9
-74	0.0014	1.05
-73	0.0017	1.275
-72	0.0019	1.425
-71	0.0023	1.725
-70	0.0026	1.95
-69	0.003	2.25
-68	0.0035	2.625
-67	0.0047	3.525
-66	0.0047	3.525
-65	0.0054	4.05
-64	0.006	4.5
-63	0.007	5.25
-62	0.008	6.0
-61	0.009	6.75
-60	0.011	8.25
-59	0.012	9.0
-58	0.014	10.5
-57	0.016	12.0
-56	0.018	13.5
-55	0.021	15.75
-54	0.024	18.0
-53	0.025	18.75

-52	0.030	22.5
-51	0.035	26.25
-50	0.040	30.0
-49	0.045	33.75
-48	0.050	37.5
-47	0.055	41.25
-46	0.060	45.0
-41	0.110	82.5
-40	0.120	90.0
-39	0.140	105.0
-38	0.160	120.0
-37	0.180	135.0
-36	0.200	150.0
-35	0.220	165.0
-34	0.250	187.5
-33	0.280	210.0
-32	0.310	232.5
-31	0.340	255.0
-30	0.370	277.5
-29	0.430	322.5
-28	0.470	352.5
-25	0.630	472.5
-24	0.700	525.0
-23	0.770	577.5
-22	0.850	637.5
-21	0.940	705.0
-20	1.030	772.5

-19	1.140	855.0
-18	1.250	937.5
-17	1.370	1027.5
-16	1.510	1132.5
-15	1.650	1237.5
-14	1.810	1357.5
-13	1.980	1485.0
-12	2.170	1627.5
-11	2.380	1785.0
-10	2.560	1920.0
-9	2.840	2130.0
-8	3.010	2257.5
-7	3.380	2535.0
-6	3.690	2767.5
-5	4.020	3015.0
-4	4.370	3277.5
-3	4.760	3570.0
-2	5.170	3877.5
-1	5.620	4215.0
0	6.110	4582.5

Design Principle of the IC570 and IC590 Series of WAVE

The intention of the IC series of machines is to minimize the footprint in terms of size and energy use. To achieve this, these machines use two alternating cold traps, each capable of holding up to 50 kg of water. The heat generated from the compressors is stored in silicone oil, which is later used to defrost the cold traps every few hours.

To ensure effective operation, the material's temperature needs to be well-controlled to avoid overwhelming the cold traps with vapor. This controlled sublimation allows for optimal drying and ensures that each drawer is individually temperature-regulated, leading to the best possible results, especially for sensitive materials such as fruits, vegetables, liquids, and more.

Another significant advantage of this technology is the reduced heat dispersion into the room. The 300 liters of silicone oil (up to 25 kWh) absorb heat from the compressors and later use it to defrost the cold trap. This process significantly reduces the need for large condensers, which would otherwise have to be mounted outside the facility.

Working Principle of the IC570 and IC590 Series of WAVE

After loading the machine, all evacuation ("Evac Valve") and drain valves ("Drain Valve") are closed. The large valves between the cold traps and the chamber ("Chamber Valve") are opened, and the vacuum valves between the cold trap and the vacuum pumps ("Vacuum Valve") are also opened to initiate the sublimation process.

During the early stages, residual heat in the drawers and ambient room temperature are sufficient to sublime water. Later, the drawers will heat the material while maintaining the chamber pressure below the set threshold. Meanwhile, the alternate cold trap continues the sublimation process.

After approximately five hours, the first cold trap is sealed from the system by closing the chamber valve ("Chamber Valve 01"). Then, its evacuation ("Evac Valve 01") and drain valve ("Drain Valve 01") are opened, and its cooling system ("Cooling System 01") is shut down. Hot silicone oil circulates through the cold trap to melt the ice. After about an hour, once the ice has melted, the compressor ("Cooling System 01") resumes operation. The drain and evacuation valves close, and the vacuum valve ("Vacuum Valve 01") reopens to bring the cold trap back to vacuum pressure. When the pressure matches the main chamber, the chamber valve reopens, and the cold trap resumes collecting water. The process then repeats for the other cold trap until the material is completely dry and ready for removal.

The Production Process

It is important to understand that two independent processes operate within the machine:

1. **Production according to the recipe**
2. **Cold trap operation sequence**

The production process regulates the heating of the material and the chamber pressure based on the selected recipe. The user can set a maximum number of heating mats that can be activated simultaneously, depending on the machine's power draw. Typically, this is set to 63 A per phase, but there are special versions with higher power capacity.

Standard settings:

- **570 MAX:** 9 shelves (3 per phase)
- **570 MAX:** 12 shelves (4 per phase)
- **570 MAX:** 15 shelves (5 per phase)
- **570 MAX:** 18 shelves (6 per phase)
- **570 MAX:** 24 shelves (8 per phase)
- **570 MAX:** 36 shelves (12 per phase)
- **590 MAX:** 36 shelves (12 per phase)

The machine automatically heats the coldest shelves first, gradually increasing the temperature. Heating pauses when the pressure reaches the recipe threshold and resumes when the pressure drops 100 mTorr below the threshold. If a heating mat sensor fails, that mat is skipped while production continues. The machine counts the net time that pressure remains below the threshold. The production process can be monitored and adjusted in real time via the "Production" menu.

The Sequence

The sequence governs the ice collection and defrosting of the cold traps. Users can monitor the operating conditions of compressors, pumps, and valves within the system.

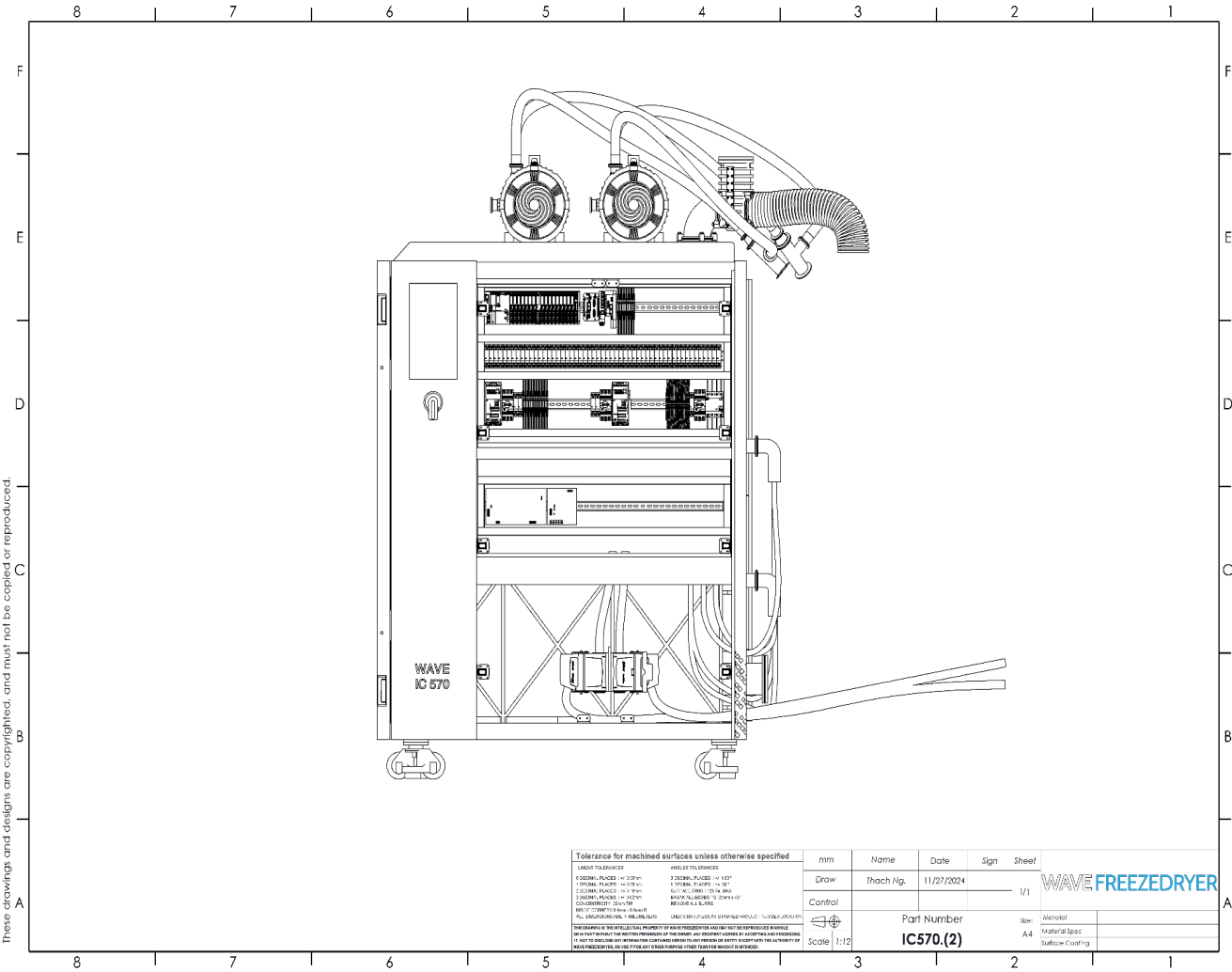
Typical cycle sequence:

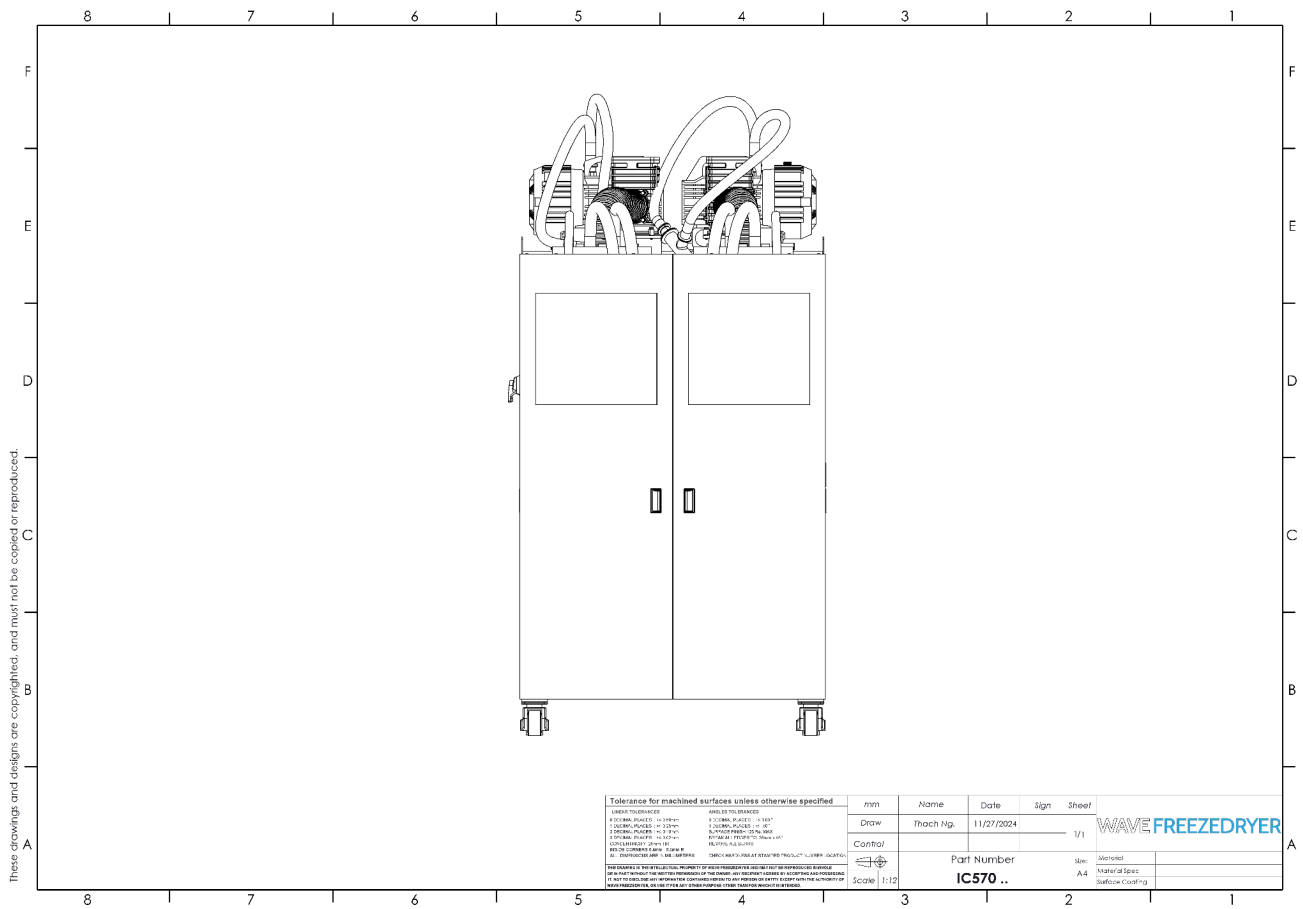
1. Both compressors ("Cooling System 01" & "Cooling System 02") operate, with the chamber valves ("Chamber Valve 01 & 02") and vacuum pump valves ("Vacuum Valve 01 & 02") open.
2. When it is time to defrost a cold trap, it is isolated from the system by closing the chamber valve and vacuum pump valve.
3. The cold trap is brought to atmospheric pressure, and the drain valve is opened to release collected water.
4. Hot oil circulates through the cold trap to melt the ice (typically taking 60–90 minutes).
5. While one cold trap defrosts, the other continues sublimation.
6. Once defrosting is complete, the pumps stop, and the compressor cools the cold trap again.
7. The drain and evacuation valves close, and the vacuum valve opens to return the cold trap to vacuum pressure.

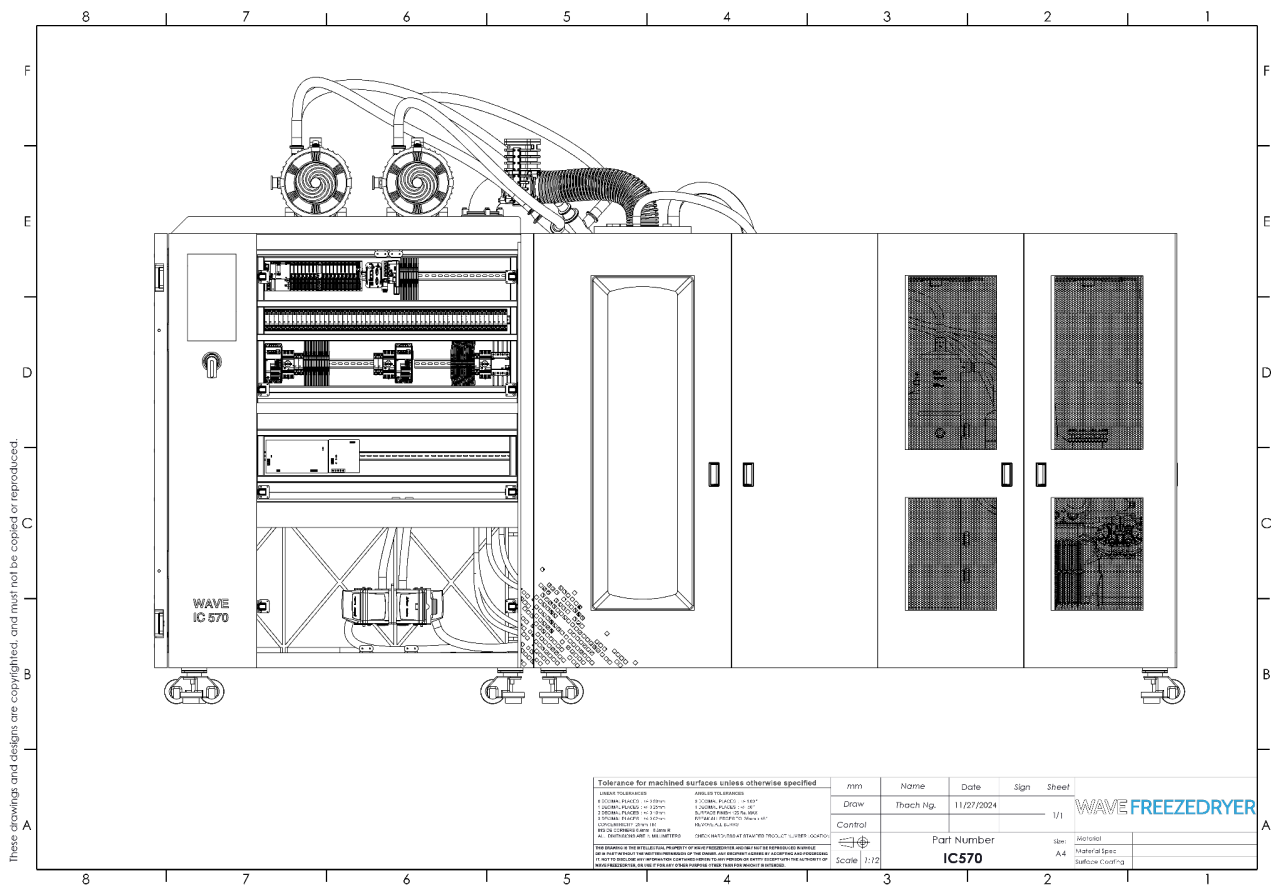
8. When the cold trap pressure equals the main chamber pressure, the main valve reopens, and water collection resumes.
9. The cycle then repeats for the alternate cold trap.

This alternating cold trap system ensures continuous, efficient freeze-drying without requiring large external condensers, making the IC570 and IC590 series an innovative solution for industrial applications.

Technical drawings 570MAX







Machine Setup and Operation

Operating the machine is a straightforward process. Follow these steps to ensure proper operation:

1. **Placement:** Position the machine in a stable, vibration-free location with temperatures below 22°C for optimal performance. Ensure the machine is on even ground and use a spirit level to verify its horizontal alignment. Note that ambient temperatures, especially during hot months, can affect drying times. The structure must support the machine's weight:
 - Front part: depending on version 1400 kg (IC570), 1900 kg (IC590)
 - Back part: depending on version 1400 kg
2. **Activate Brakes:** If the device is equipped with casters, engage all brakes once in its final position.
3. **Safety Checks:** Inspect for transport-related issues, especially leaks in the cooling system. Refer to the operating instructions for specific cooling systems (Embraco, Tecumseh, or Blitzer) and adhere to national regulations. Ensure the door is correctly positioned and avoid placing weight on it.
4. **Power Connection:**

In Europe: 400V three-phase, 230V per phase, rated 63A per phase, one neutral, and one ground.

 - In the US: 240V; can run without neutral if necessary.
 - Turn on the FI switch in the fuse box, then power the machine using the main switch below the HMI.
 - The PLC will indicate readiness with a beep, and the display should illuminate.
5. **Vacuum Pump Setup:**
 - Ensure the vacuum pump is on a level, dry, and well-ventilated surface with sufficient clearance.
 - Connect the pump to the vacuum chamber using clamps.
 - The pump can be placed beside the machine or on top if the machine is equipped for that.
 - Confirm voltage compatibility with the nameplate.
6. **Language and Settings:**
 - Access "Menu Settings" to select the preferred language and configure time and date.
7. **Component Functionality Check:**
 - Use the "Control" section to verify all machine components before initiating a cycle: heating mats, cooling system, vacuum pump, and valves.

Controls Menu

- **Cooling System 01 & 02:** Activates compressors.
- **Evac Valve 01 & 02:** Evacuates the cold trap.
- **Evac Valve Main:** Evacuates the chamber after drying.
- **Drain Valve 01 & 02:** Drains melted water from the cold trap.
- **Chamber Valve 01 & 02:** Connects the chamber to the cold trap via ISO100 flexible pipes.
- **Vacuum Pump:** Various models available (100-300 m³/h), powered separately.
- **Oil Pumps 1A-1C, 2A-2C:** Circulate hot silicone oil through the cold trap during defrost mode.
- **Heating Mats (1-54):** Heat the drying material up to 70°C, individually controlled.

Automated Components

- **Oil Heater Compressors 01 & 02:** Ensure the compressor oil remains warm for smooth startup.

Sensors

- **Vacuum Sensor Chamber:** Measures chamber pressure (mBar/mTorr).
- **Vacuum Sensor CT1 & CT2:** Measure cold trap pressure.
- **Ambient Temperature 1 (Front) & 2 (Back):** Monitor system conditions.
- **Cold Trap Sensor 1 & 2:** Measure cold trap temperature.
- **Compressor Pressure 1 & 2 High/Low:** Monitor compressor health.
- **Compressor Temperature 1 & 2 High/Low:** Track refrigerant entry/exit temperatures.
- **Oil Temperature:** Measures oil tank temperature.

Safety Systems

- **Pressure Plates 1A, 1B, 2A, 2B:** Ensure 10mm thick plates are in place to prevent chamber deformation.
- **Compressor High-Pressure Cutoff:** Stops operation if pressure exceeds 32 Bar.
- **Compressor Low Oil Volume Cutoff:** Stops compressor if oil is insufficient.
- **Compressor Voltage Overload Cutoff:** Cuts power if motor resistance/load is too high.
- **Heating Mats Safety Relay:** Cuts power if one heating mat exceeds the maximum set temperature.

This document provides essential steps and system details for the proper setup and operation of the IC570 and IC590 machines. Ensure all procedures are followed to maintain safety and efficiency.

Cleaning and Waste Water Management

Proper cleaning and maintenance of the machine are essential for its longevity and the quality of the products it processes. Follow these guidelines:

1. **Post-Cycle Cleaning:** After each drying cycle, it's crucial to clean the trays. If you've processed materials containing toxic substances, perform an exceptionally thorough cleaning to eliminate any residues from the vacuum chamber, trays, or anywhere in the drying room. (Refer to safety instructions for additional guidance).
2. **Product Switch Cleaning:** When transitioning from one dry product to another, especially if the new material has strong aromas or involves animal or dairy products, we recommend a meticulous cleaning of the machine.
3. **Door Cleaning:** Wipe the inside of the door with a soft, damp cloth. This action not only maintains cleanliness but also aids in creating a proper vacuum. Use only soft cloths to prevent scratches on the door's surface. If the door does become scratched, it can be restored using a suitable acrylic polishing cream.
4. **Drawer and Vacuum Chamber Cleaning:** In addition to cleaning the trays, ensure the body of the drawer and the vacuum chamber are thoroughly cleaned.
5. **Chemical Caution:** Never employ acetone, bleach, chlorine, nitro, or harsh chemicals/solvents to clean any internal or external parts of the machine.
6. **Toxic Substance Disposal:** If you're drying materials from which toxins are extracted with water, make sure the extracted liquid is disposed of properly, following safety instructions.
7. **Manual Cleaning and MULE:** For preparation, removal of the drawer unit, material compatibility and documented release, see "Cleaning, disinfection and MULE" (supplement C1-C3; PDF pages 108-110). Follow the instructions for the supplied configuration.

By following these cleaning and maintenance guidelines, you can ensure the longevity and effectiveness of your machine.

Cooling System Operation

Do not start the compressor in cold conditions.. Be certain that the entire compressor is adequately warmed, which typically takes about 30 minutes. Once it's running, a lower ambient temperature is acceptable.

The cooling system comprises several key components, including the compressor, condenser, bubble glass, filter, vessel, and the TXV valves.

If you encounter performance issues with the compressor, check the bubble glass for any bubbles. The presence of bubbles indicates a refrigerant leak, and it's essential to have an HVAC technician inspect and repair the unit.

For detailed guidance on your specific cooling system (Embraco, Tecumseh, or Bitzer), please refer to the operating instructions provided in the manual sent to you. Additionally, adhere to national regulations concerning the handling of cooling systems.

Be aware that regular service intervals may vary by region. Consult your local requirements to determine the recommended maintenance schedules for your cooling system.

By following these guidelines, you can maintain the optimal performance of your compressor and cooling system while ensuring its longevity and efficiency.

Vacuum Pump Operation

The vacuum pump may vary depending on the specific machine, so it's essential to reference the provided operating instructions for your specific model. Proper maintenance is crucial, including regular oil changes if your pump is not oil-free. The user manual will offer detailed guidance on installation and pump connection.

Maintaining the pump's performance requires that the ballast on the pump remains fully open.

Both oil pumps and drive pumps feature a ballast button to regulate air intake, crucial for removing water from within the pump.

When installing the pump, ensure it's placed in a suitable environment: a straight, dry, and cool location with adequate ventilation and safety clearance.

For machines equipped with an oil vacuum pump, avoid starting the pump until the internal chamber temperature is below freezing. Operating the pump in a warm chamber can quickly lead to contamination of the pump's oil, necessitating immediate replacement.

Please note that only specific oils are compatible with the vacuum pumps we supply.

Following these instructions will help ensure the efficient and safe operation of your vacuum pump, prolonging its lifespan and optimizing its performance.

PLC / Remote Maintenance Guidelines

The Wave IC series is furnished with a Siemens Simatic PLC, characterized by its modular structure that allows for future expansions, modernization, and upgrades to the latest generation of machine control. This Simatic system is managed through the HMI and is inherently maintenance-free.

Remote maintenance is a seamless option, requiring Ethernet access from the PLC to a network-connected PC. This connection is established through the Ethernet port on the switch box using a CAT6 cable, granting access to the Wave IC series from external locations, such as via Teamviewer. This facilitates the retrieval of system data and the verification of functions through remote monitoring.

For machines equipped with the Internet Module and a Corvina license, the IC series can be controlled via smartphone or desktop.

Surface Maintenance

The surfaces of the drawers, the drawer body, and the vacuum chamber are hard anodized, with a thickness of 25 micrometers (25um), making them certified as food-safe surfaces. These surfaces can be effectively cleaned using a gentle cleaning agent.

Menu Navigation

The freeze dryer features a user-friendly touch screen interface. Each button press triggers a specific function, ranging from opening dialog boxes to adjusting values or confirming actions. This intuitive design allows for flexible and precise control of all machine components to handle goods effectively.

However, please ensure that your fingers are clean when interacting with the screen. Dirty or oily hands can interfere with the screen's responsiveness and lead to malfunctions. It's crucial to avoid using solvents for cleaning the monitor. Also, refrain from using any hard objects like metal, screwdrivers, or wood to interact with the screen to prevent damage.

Settings Menu Overview (IC570/IC590 Series)

The **Settings Menu** in the IC570/IC590 freeze-drying system allows users to configure key operational parameters for optimal performance. Below is an explanation of the functions available in this menu:

1. Date & Time Configuration

- **Date (DD/MM/YYYY)** → Allows the user to set the system date.
- **Time (HH/MM/SS)** → Enables the adjustment of the system clock.

2. Temperature & Power Settings

- **Maximum Drawers Temperature** → Defines the highest temperature the heating elements (mats) can reach. Default: **60.0°C**.
- **Temperature Limit to Stop Machine** → If this threshold (**85.0°C**) is reached, the system will halt to prevent overheating.
- **Max Drawers to heat** → Set the amount of Drawers that will be turned on at the same time in regards of your power supply.

Additional Interface Features

- **START Production** → Begins the process of drawer heating regarding the recipe.
- **End Production** → Ends the process of drawer heating regarding the recipe.
- **Start Sequence** → Starts the Coldtrap Sequence
- **End Sequence** → Ends the Coldtrap Sequence



Statistics Menu Overview (IC570/IC590 Series)

The **Statistics Menu** in the IC570/IC590 freeze-drying system provides real-time monitoring and historical analysis of critical process parameters. This section serves as a vital tool for optimizing drying performance, identifying potential technical issues, and ensuring efficient energy usage.

1. General Information Displayed

- **Stage Number:** Indicates the current production stage.
- **Vacuum Level:** Displays the real-time vacuum pressure in **mTorr**.
- **Cold Trap 1 Temperature (CT1 Temp):** Shows the temperature of the first cold trap.
- **Cold Trap 2 Temperature (CT2 Temp):** Displays the temperature of the second cold trap.
- **Total Power Consumption:** Monitors the current energy consumption in **Watts (W)**.
- **Average Drawer Temperature:** Provides an average temperature reading across all drying drawers.
- **Sequence Stage Number:** Displays the current sequence stage of the freeze-drying process.

Additionally, in this menu, users can access the **machine type number** and **total number of freeze-drying runs completed**, allowing them to track the machine's usage history and performance over time.

2. Graphical Data Display

The statistics graph presents a **visual representation of key machine parameters**, allowing users to identify trends and make informed adjustments:

- **Temperature Curves (°C):** Tracks drawer temperatures, cold trap temperatures, and heating behavior.
- **Vacuum Levels (mTorr):** Displays fluctuations in vacuum pressure throughout the drying cycle.
- **Power Consumption (W):** Monitors changes in energy usage to ensure efficiency.
- **Process Stage Transitions:** Marks changes between different drying phases for better process control.

Each parameter is **color-coded** to enhance visibility and ease of analysis.

3. Timeframe Selection

Users can **adjust the displayed time range** to analyze trends over different periods:

- **24h (Green Indicator):** View data from the last **24 hours**.
 - **8h (Yellow Indicator):** Display the last **8 hours** of data.
 - **3h (Orange Indicator):** Show the last **3 hours** of process data.
 - **1h (Red Indicator):** Zoom into the last **1 hour** for detailed analysis.
-

4. Live Monitoring & Drying Profiles

While the drying process is running, users can **observe live drying profiles**, providing real-time insights into system performance. These profiles are essential for: ✓ **Fine-tuning the process** to achieve the best drying results. ✓ **Optimizing drying time and energy efficiency** by detecting patterns. ✓ **Early identification of technical issues**, such as inconsistent vacuum pressure or temperature fluctuations.

5. Key Patterns to Observe

By analyzing trends within the Statistics Menu, users can **improve process efficiency** by identifying and responding to crucial patterns:

1. Notable Temperature Fluctuations

- Some fluctuations are **normal**, but excessive variations may indicate that:
 - The **chosen drying temperature is too high** for the material.
 - The **vacuum pump output is insufficient**, leading to unstable conditions.

2. Phases with Stable Temperature & Vacuum

- These periods indicate **efficient drying**, where:
 - The **extraction rate aligns with the pump's capacity**.
 - The system is functioning optimally.

3. Phases with Stable Temperature but Increasing Pressure

- These phases suggest **inefficient drying**, where:
 - **No significant water extraction** is occurring.
 - Adjustments to **temperature or vacuum settings** may be necessary to resume effective drying.

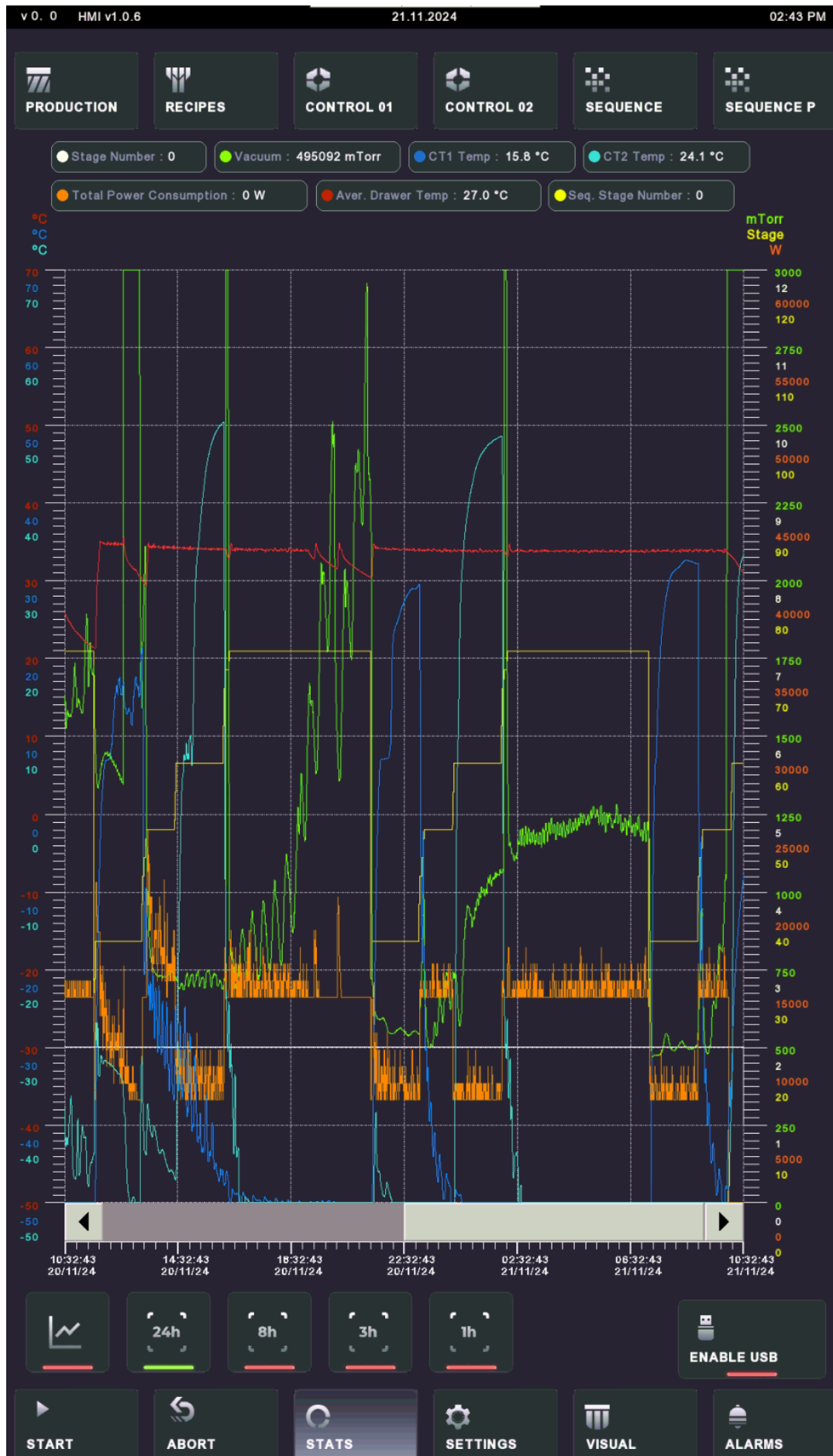
By recognizing these **key drying patterns**, users can proactively **optimize drying cycles**, minimize downtime, and ensure consistent product quality.

6. Purpose and Benefits

The **Statistics Menu** is an essential feature for machine operators and process engineers, providing: ✓ **Real-time performance monitoring** to prevent inefficiencies. ✓ **Identification of drying inefficiencies** through data analysis. ✓ **Optimization of drying cycles** for reduced energy consumption. ✓ **Preventive maintenance insights** by detecting early warning signs. ✓ **Improved product consistency and quality control** through data-driven adjustments.

With the **IC570/IC590 Series Statistics Menu**, users can achieve **maximum process efficiency, reduce energy waste, and ensure high-quality freeze-drying results.**

This comprehensive system ensures that the freeze-drying process is monitored, optimized, and controlled effectively, enhancing both productivity and reliability.



Menu item "**Recipes**"

Main Functions

1. Recipe Selection

- The main section displays different **recipes** such as "Apples," "CBD Standard," "Milk," etc.
 - Each recipe box contains:
 - **Recipe name**
 - **Drying duration** (in hours)
 - **Stages** (number of drying steps)
 - **Last used date**
-

2. Recipe Management Buttons

Located at the bottom of the screen, these buttons allow users to manage recipes effectively.

- **DELETE** → Removes the selected recipe.
 - **NEW** → Creates a new recipe.
 - **COPY** → Duplicates an existing recipe for modification.
 - **LOAD** → Loads a selected recipe for processing.
-

How to Use the Recipe System

1. **Select a Recipe** → Tap on the desired recipe.
2. **Modify (if needed)** → Copy an existing recipe and adjust the parameters.
3. **Load Recipe** → Press **LOAD** to prepare the machine.
4. **Start Process** → Press **START** to begin the freeze-drying cycle.
5. **Monitor & Adjust** → Use **STATS** and **VISUAL** for real-time tracking.

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PRODUCTION

RECIPES

CONTROL 01

CONTROL 02

SEQUENCE

SEQUENCE P

All

Fruit

Berry

Vegetable

Bud

Herbs

Seeds

Liquids

Proteins

Specials

Apples

No Tag

023 hrs

Last used0 daysStages4

Algae

No Tag

028 hrs

Last used0 daysStages4

CBD Standard

No Tag

719 hrs

Last used139 daysStages4

CBD Quick

No Tag

012 hrs

Last used0 daysStages4

CBD Fine

No Tag

017 hrs

Last used0 daysStages5

Ceramic powder

No Tag

024 hrs

Last used0 daysStages6

Gelatine

No Tag

028 hrs

Last used0 daysStages4

Honey

No Tag

025 hrs

Last used0 daysStages8

Meat

No Tag

028 hrs

Last used0 daysStages4

Milk

No Tag

024 hrs

Last used0 daysStages7

Apricot

No Tag

017 hrs

Last used0 daysStages5

Strawberry

No Tag

326 hrs

Last used132 daysStages6

Raspberry

No Tag

030 hrs

Last used0 daysStages6

Vegetables

No Tag

020 hrs

Last used0 daysStages5

DELETE

NEW

COPY

LOAD

PAUSE PRODUCTION

SEQUENCE CONTINUE

START LOADING

VISUALS

STATISTICS

ALARMS

END PRODUCTION

END SEQUENCE

DONE LOADING

LIGHT

COMPRESSOR STATISTICS

SETTINGS

Menu item “Control 1”

Overview

The **Heater Drawer Control Screen** allows users to **monitor and adjust** the heating parameters of multiple drawers in a freeze-drying system. Each drawer's temperature can be controlled automatically or manually.

Main Functions

1. Heater Drawer Monitoring

- Each **heater drawer** is displayed as a separate unit.
 - Key parameters shown for each drawer:
 - **Auto/Manual Mode**
 - **Setpoint Temperature (SP)**
 - **Current Temperature**
-

2. Control Options for All Drawers

Located at the bottom of the drawer list, these buttons provide bulk control:

- **SET ALL DRAWERS TO AUTO** → Automatically adjusts all heater drawers.
- **SET ALL DRAWERS TO MANUAL OFF** → Turns off all heaters manually.
- **APPLY CHANGES** → Confirms any modifications made.

Additionally, ambient temperature sensors:

- **Ambient Front** → Displays the temperature in the front section.
 - **Ambient Back** → Displays the temperature in the rear section.
-

How to Use the Heater Drawer Control

- 1 **Monitor Drawers** → Check the current temperature status of each heater drawer.
- 2 **Adjust Settings** → Switch between auto/manual control for drawers as needed.
- 3 **Apply Bulk Changes** → Use the "SET ALL DRAWERS" options for quick adjustments.

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PRODUCTION

RECIPES

CONTROL 01

CONTROL 02

SEQUENCE

SEQUENCE P

DRAWERS

Heater Drawer 01

Auto

SP : 25.0 °C

25.9 °C

Heater Drawer 13

Auto

SP : 25.0 °C

25.8 °C

Heater Drawer 25

Auto

SP : 25.0 °C

25.4 °C

Heater Drawer 37

Auto

SP : 25.0 °C

26.1 °C

Heater Drawer 49

Auto

SP : 25.0 °C

25.6 °C

Heater Drawer 02

Auto

SP : 25.0 °C

26.0 °C

Heater Drawer 14

Auto

SP : 25.0 °C

25.9 °C

Heater Drawer 26

Auto

SP : 25.0 °C

25.2 °C

Heater Drawer 38

Auto

SP : 25.0 °C

26.1 °C

Heater Drawer 50

Auto

SP : 25.0 °C

25.6 °C

Heater Drawer 03

Auto

SP : 25.0 °C

25.9 °C

Heater Drawer 15

Auto

SP : 25.0 °C

25.9 °C

Heater Drawer 27

Auto

SP : 25.0 °C

24.8 °C

Heater Drawer 39

Auto

SP : 25.0 °C

26.1 °C

Heater Drawer 51

Auto

SP : 25.0 °C

25.5 °C

Heater Drawer 04

Auto

SP : 25.0 °C

25.8 °C

Heater Drawer 16

Auto

SP : 25.0 °C

25.9 °C

Heater Drawer 28

Auto

SP : 25.0 °C

26.2 °C

Heater Drawer 40

Auto

SP : 25.0 °C

26.1 °C

Heater Drawer 52

Auto

SP : 25.0 °C

25.4 °C

Heater Drawer 05

Auto

SP : 25.0 °C

25.9 °C

Heater Drawer 17

Auto

SP : 25.0 °C

25.8 °C

Heater Drawer 29

Auto

SP : 25.0 °C

26.4 °C

Heater Drawer 41

Auto

SP : 25.0 °C

26.0 °C

Heater Drawer 53

OFF

SP : 25.0 °C

25.2 °C

Heater Drawer 06

Auto

SP : 25.0 °C

26.0 °C

Heater Drawer 18

Auto

SP : 25.0 °C

25.6 °C

Heater Drawer 30

Auto

SP : 25.0 °C

26.4 °C

Heater Drawer 42

Auto

SP : 25.0 °C

26.1 °C

Heater Drawer 54

Auto

SP : 25.0 °C

25.0 °C

Heater Drawer 07

Auto

SP : 25.0 °C

25.9 °C

Heater Drawer 19

Auto

SP : 25.0 °C

25.7 °C

Heater Drawer 31

Auto

SP : 25.0 °C

26.4 °C

Heater Drawer 43

Auto

SP : 25.0 °C

26.0 °C

Heater Drawer 08

Auto

SP : 25.0 °C

26.0 °C

Heater Drawer 20

Auto

SP : 25.0 °C

25.6 °C

Heater Drawer 32

Auto

SP : 25.0 °C

26.3 °C

Heater Drawer 44

Auto

SP : 25.0 °C

26.0 °C

Heater Drawer 09

Auto

SP : 25.0 °C

25.9 °C

Heater Drawer 21

Auto

SP : 25.0 °C

25.6 °C

Heater Drawer 33

Auto

SP : 25.0 °C

26.3 °C

Heater Drawer 45

Auto

SP : 25.0 °C

25.7 °C

Heater Drawer 10

Auto

SP : 25.0 °C

25.9 °C

Heater Drawer 22

Auto

SP : 25.0 °C

25.6 °C

Heater Drawer 34

Auto

SP : 25.0 °C

26.2 °C

Heater Drawer 46

Auto

SP : 25.0 °C

25.9 °C

Heater Drawer 11

Auto

SP : 25.0 °C

25.9 °C

Heater Drawer 23

Auto

SP : 25.0 °C

25.5 °C

Heater Drawer 35

Auto

SP : 25.0 °C

26.1 °C

Heater Drawer 47

Auto

SP : 25.0 °C

25.8 °C

Heater Drawer 12

Auto

SP : 25.0 °C

25.8 °C

Heater Drawer 24

Auto

SP : 25.0 °C

25.6 °C

Heater Drawer 36

Auto

SP : 25.0 °C

26.1 °C

Heater Drawer 48

Auto

SP : 25.0 °C

25.9 °C

SET ALL DRAWERS TO AUTO

SET ALL DRAWERS TO MANUAL OFF

Ambient Front

23.4 °C

Ambient Back

24.7 °C

APPLY CHANGES

PAUSE PRODUCTION

SEQUENCE CONTINUE

START LOADING

VISUALS

STATISTICS

ALARMS

Menu item “Control 2”

Overview

The **System Control Screen (CONTROL 02)** provides a detailed overview of key **cooling, vacuum, valve, and defrost pump systems**. This screen allows operators to monitor and adjust system components to ensure optimal freeze-drying performance.

Main Functions

1. Cooling System Monitoring

- Displays the **status and temperature** of:
 - **Cooling System 01 & 02**
 - **Oil Tank**
 - Each system can be set to **Auto Mode** for automated control.
-

2. Defrost Pumps Control

- **Coldtrap Pump 01 & 02**: Manages defrosting operations.
 - Both pumps have real-time **temperature monitoring** and **Auto Mode** capability.
-

3. Valve Control System

- **Chamber Valves (01 & 02)**: Controls pressure regulation in the drying chamber.
 - **Evacuation Valves (01 & 02)**: Manages the removal of air/vapor from the chamber.
 - **Drain Valves (01 & 02)**: Handles condensation drainage.
 - **Vacuum Valves (01 & 02)**: Ensures proper vacuum levels for efficient drying.
 - **Main Evacuation Valve**: Oversees overall system evacuation.
 - **All valves** can be set to **Auto Mode** for seamless operation.
-

4. Vacuum System Monitoring

- **Vacuum Pump Status**: Displays the **current vacuum pressure** in **mTorr/mBar**.
 - Ensures proper vacuum control for **efficient freeze-drying**.
-

5. Additional Features

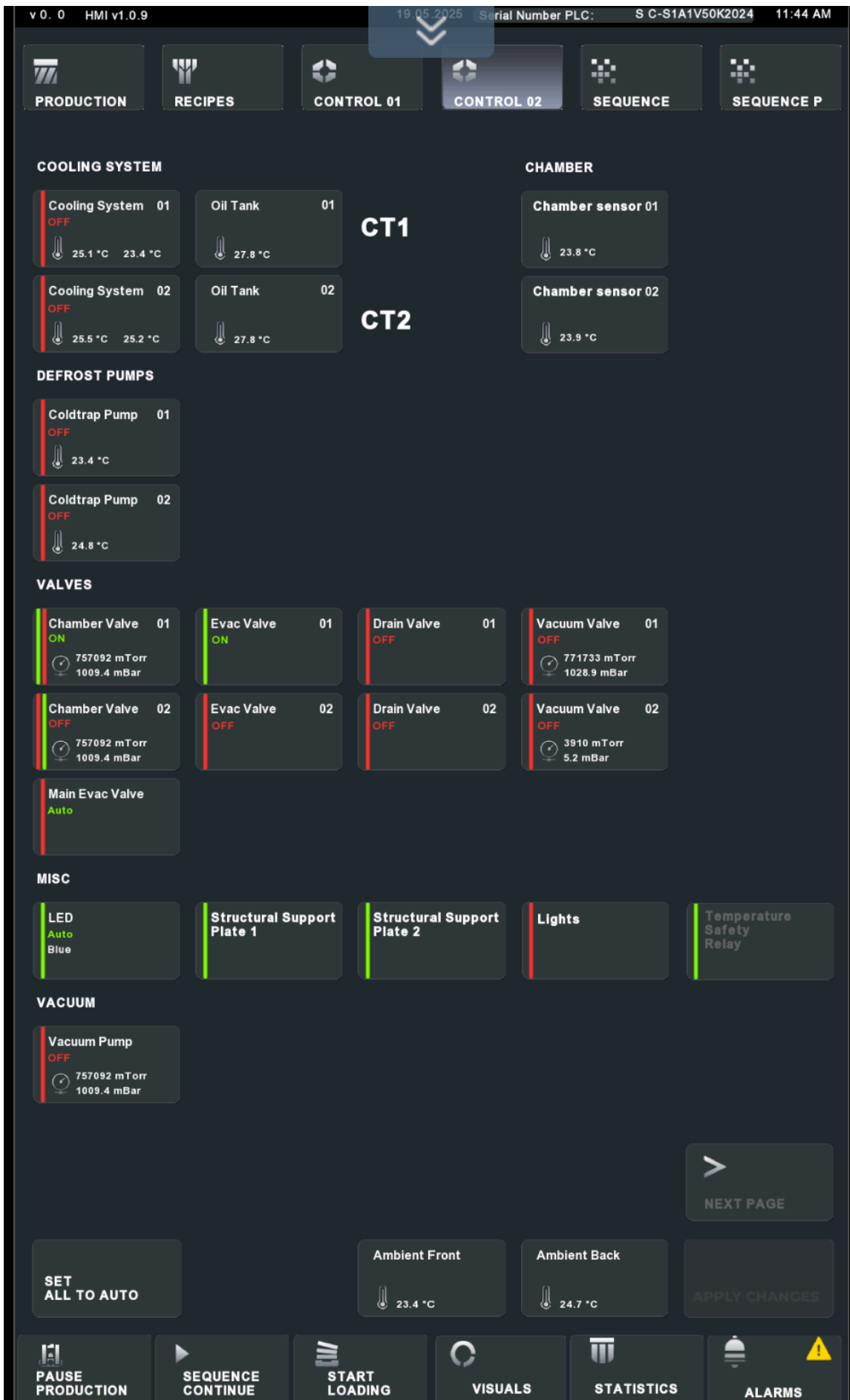
- **Ambient Temperature Monitoring** → Displays temperatures at **Front** and **Back** of the system.

6. Bulk Control & Adjustments

- **SET ALL TO AUTO** → Automatically configures all components for optimal performance.
 - **APPLY CHANGES** → Saves adjustments made to any system settings.
-

How to Use the System Control Screen

- 1 **Monitor System Components** → Check cooling, vacuum, and valve statuses.
- 2 **Adjust Auto/Manual Settings** → Switch between auto and manual modes for specific components.
- 3 **Set All to Auto** → Configure the entire system for automated operation.
- 4 **Monitor Performance** → Use the **Ambient Temperature & Vacuum Readings** for real-time data.
- 5 **Apply Changes & Start Process** → Confirm settings and initiate the drying cycle.



Menu item "**Production**"

Overview

The **Recipe Configuration Screen** allows users to set and modify drying parameters for different freeze-drying recipes. This interface is essential for optimizing drying processes by adjusting time, temperature, and pressure settings for each drying stage.

Main Functions

1. Recipe Selection & Stages

- The current **recipe name** is displayed at the top (e.g., "Apples").
 - **Stages** represent different drying phases in the process:
 - Users can **add new drying stages** by pressing the "**ADD DRY STAGE**" button.
-

2. Stage Configuration

For each stage, users can define:

- **Set Time** → Duration of the stage (e.g., 1 hr 0 min for Stage One, 40 hrs 0 min for Stage Two).
 - **Set Temperature** → Target shelf temperature (e.g., +10.0°C for Stage One, +40.0°C for Stage Two).
 - **Set Pressure** → Desired vacuum pressure (e.g., 1500 mTorr for both stages).
 - **Current Temperature & Pressure** values are displayed for real-time monitoring.
 - **Increase/Decrease Controls** (+ / - buttons) allow for precise adjustments.
-

3. Process Monitoring

- **Total Time** → Displays the total duration of all stages.
 - **Elapsed Time** → Tracks the progress of the running process.
 - **Remaining Time** → Shows the time left for completion.
-

4. Recipe Management Controls

- **SAVE AS NEW** → Creates a new recipe with the configured settings.
 - **SAVE** → Saves modifications to the existing recipe.
 - **LOAD** → Loads a previously saved recipe for further adjustments.
-

How to Use the Recipe Configuration Screen

- 1 **Select a Recipe** → Choose an existing recipe or create a new one.
- 2 **Modify Stages** → Adjust time, temperature, and pressure for each stage.
- 3 **Add Additional Stages** → Press "**ADD DRY STAGE**" if more phases are required.
- 4 **Save Changes** → Use **SAVE** or **SAVE AS NEW** to store modifications.
- 5 **Start the Process**
- 6 **Monitor Progress** → Use the elapsed and remaining time indicators to track the process.

PRODUCTION

RECIPES

CONTROL 01

CONTROL 02

SEQUENCE

SEQUENCE P

RECIPE

Strawberry

STAGE ONE	Set Time 5 hrs 0 min Current Time	Set Temperature -10.0 °C Current Temperature	Set Pressure 600 mTorr Current Pressure	+ -
STAGE TWO	Set Time 5 hrs 0 min Current Time	Set Temperature +10.0 °C Current Temperature	Set Pressure 800 mTorr Current Pressure	+ -
STAGE THREE	Set Time 4 hrs 0 min Current Time	Set Temperature +11.0 °C Current Temperature	Set Pressure 600 mTorr Current Pressure	+ -
STAGE FOUR	Set Time 4 hrs 0 min Current Time	Set Temperature +22.0 °C Current Temperature	Set Pressure 800 mTorr Current Pressure	+ -
STAGE FIVE	Set Time 50 hrs 0 min Current Time 17 hrs 32 min	Set Temperature +25.0 °C Current Temperature +25.9 °C	Set Pressure 800 mTorr Current Pressure 757092 mTorr	+ -
STAGE SIX	Set Time 50 hrs 0 min Current Time	Set Temperature +45.0 °C Current Temperature	Set Pressure 600 mTorr Current Pressure	+ -

+

ADD DRY STAGE

Total Time
113 : 00 : 00

Elapsed Time
132 : 33 : 00

Remaining Time
0 : 00 : 00

↓
SAVE AS NEW

↓
SAVE

↑
LOAD

PAUSE PRODUCTION

END PRODUCTION

SEQUENCE CONTINUE

END SEQUENCE

START LOADING

DONE LOADING

VISUALS

LIGHT

STATISTICS

COMPRESSOR STATISTICS

ALARMS

SETTINGS

43

Sequence Execution Screen

Overview

The **Sequence Execution Screen** is responsible for managing and monitoring the step-by-step execution of the Coldtrap process. It displays the current stage, elapsed and remaining time, and allows users to control the sequence execution in real-time.

Main Functions

1. In-Progress Section

- Displays **current process status** with the following details:
 - **Stage Number** – Indicates the active step in the sequence.
 - **Type** – Specifies the process phase (e.g., Beginning, Drying, End).
 - **Component** – Identifies the system part being controlled (e.g., Valves, Compressors).
 - **Action** – Shows what the component is doing (e.g., Open, Close, Wait, On).
 - **Action Value** – Displays any numerical settings such as **wait time** (e.g., 2.0 min).
 - **Elapsed Time & Remaining Time** indicators track the execution progress.
-

2. Sequence Overview (ALL SEQUENCE)

- Lists **all programmed steps** for the sequence, allowing users to review and follow the process.
-

3. Navigation & Control

- **PREV. PAGE / NEXT PAGE** → Navigate through sequence steps if the list is long.
 - **PAUSE SEQUENCE** → Temporarily stops the execution without resetting progress.
 - **START SEQUENCE** → Begins or resumes the sequence.
 - **STOP SEQUENCE** → Completely halts the sequence execution.
-

How to Use the Sequence Execution Screen

- 1 **Monitor Current Progress** → Check the active stage, elapsed time, and remaining time.
- 2 **Review the Sequence** → Analyze all steps in the sequence list to ensure proper execution.

- ③ **Control Execution** → Use **Start, Pause, or Stop** to manage the sequence.
- ④ **Navigate Through Steps** → If the sequence has many steps, use **Prev/Next Page** for better visibility.
- ⑤ **Adjust Settings if Necessary** → If needed, modifications can be made in the **Settings** menu.

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PRODUCTION

RECIPES

CONTROL 01

CONTROL 02

SEQUENCE

SEQUENCE P

IN PROGRESS

Stage	Type	Component	Action	Action Value
40	CT2	None	Wait	10.0 min

Elapsed Time

5 min 5 sec

Remaining Time

4 min 55 sec

ALL SEQUENCE

Stage	Type	Component	Action	Action Value
51	CT2	None	Wait	2.0 min
52	CT2	Defrost Pump 2	Off	
53	CT2	Evac Valve 2	Close	
54	CT2	Compressor 2	On	
55	CT2	None	Reach Temp. CT2	-15.0 °C
56	CT2	Vacuum Valve 2	Open	
57	CT2	None	Reach Vac. CT2	1500.0 mTorr
58	CT2	Chamber Valve 2	Open	
59	CT2	None	Wait	350.0 min
60	CT2	None	Go to	21.0 stage

SKIP STAGE

<

PREV. PAGE

>

NEXT PAGE

PAUSE PRODUCTION

SEQUENCE CONTINUE

START LOADING

VISUALS

STATISTICS

ALARMS

END PRODUCTION

END SEQUENCE

DONE LOADING

LIGHT

COMPRESSOR STATISTICS

SETTINGS

46

Sequence Configuration Screen

Overview

The **Sequence Configuration Screen** allows users to create, modify, and manage process sequences for the freeze-drying system. Each step of the sequence defines actions for system components, ensuring an automated and structured drying process.

Main Functions

1. Sequence Setup & Parameters

- **Stage** → Indicates the step number in the sequence.
- **A/D (Automatic/Defined Mode)** → Displays whether the step is set to automatic (A) or manually defined (D).
- **Type** → Defines the stage phase (e.g., Beginning, Main Process, End).
- **Component** → Identifies which part of the system is affected (e.g., Valves, Compressors).
- **Action** → Specifies the operation performed (e.g., Open, Close, On, Wait).
- **Action Value** → Displays specific values like wait time (e.g., 2.0 min).

Each step can be modified using dropdown menus, allowing users to **customize** the sequence to fit process needs.

2. Sequence Navigation & Control

- **Stack No.: 1** → Identifies the active sequence stack.
 - **PREV. PAGE / NEXT PAGE** → Used to navigate through multiple sequence steps.
 - **EDIT** → Allows modification of existing sequence steps.
-

How to Use the Sequence Configuration Screen

- 1 **Review Sequence Steps** → Analyze each stage to ensure correct execution order.
- 2 **Modify Actions if Needed** → Click **EDIT** to change components, actions, or values.
- 3 **Set Automatic or Defined Mode** → Adjust **A/D settings** for full automation or manual control.
- 4 **Navigate Through Pages** → Use **Prev/Next Page** for long sequences.

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PRODUCTION

RECIPES

CONTROL 01

CONTROL 02

SEQUENCE

SEQUENCE P

SEQUENCE CONFIG

Stack No:

Stage	A/D	Type	Component	Action	Action Value
51	A	CT2	None	Wait	2.0 min
52	A	CT2	Defrost Pump 2	Off	
53	A	CT2	Evac Valve 2	Close	
54	A	CT2	Compressor 2	On	
55	A	CT2	None	Reach temp CT2	-15.0 °C
56	A	CT2	Vacuum Valve 2	Open	
57	A	CT2	None	Reach vac. CT2	1500.0 mTorr
58	A	CT2	Chamber Valve 2	Open	
59	A	CT2	None	Wait	350.0 min
60	A	CT2	None	Go to	21.0 stage

EDIT

PREV. PAGE

NEXT PAGE

PAUSE PRODUCTION

SEQUENCE CONTINUE

START LOADING

VISUALS

STATISTICS

ALARMS

END PRODUCTION

END SEQUENCE

DONE LOADING

LIGHT

COMPRESSOR STATISTICS

SETTINGS

Visual Monitoring Screen

Overview

The **Visual Monitoring Screen** provides a graphical representation of the freeze-drying system, displaying real-time temperature and pressure readings for key components such as **compressors, cooling elements, and valves**. This screen allows operators to monitor system performance visually and detect issues efficiently.

Main Functions

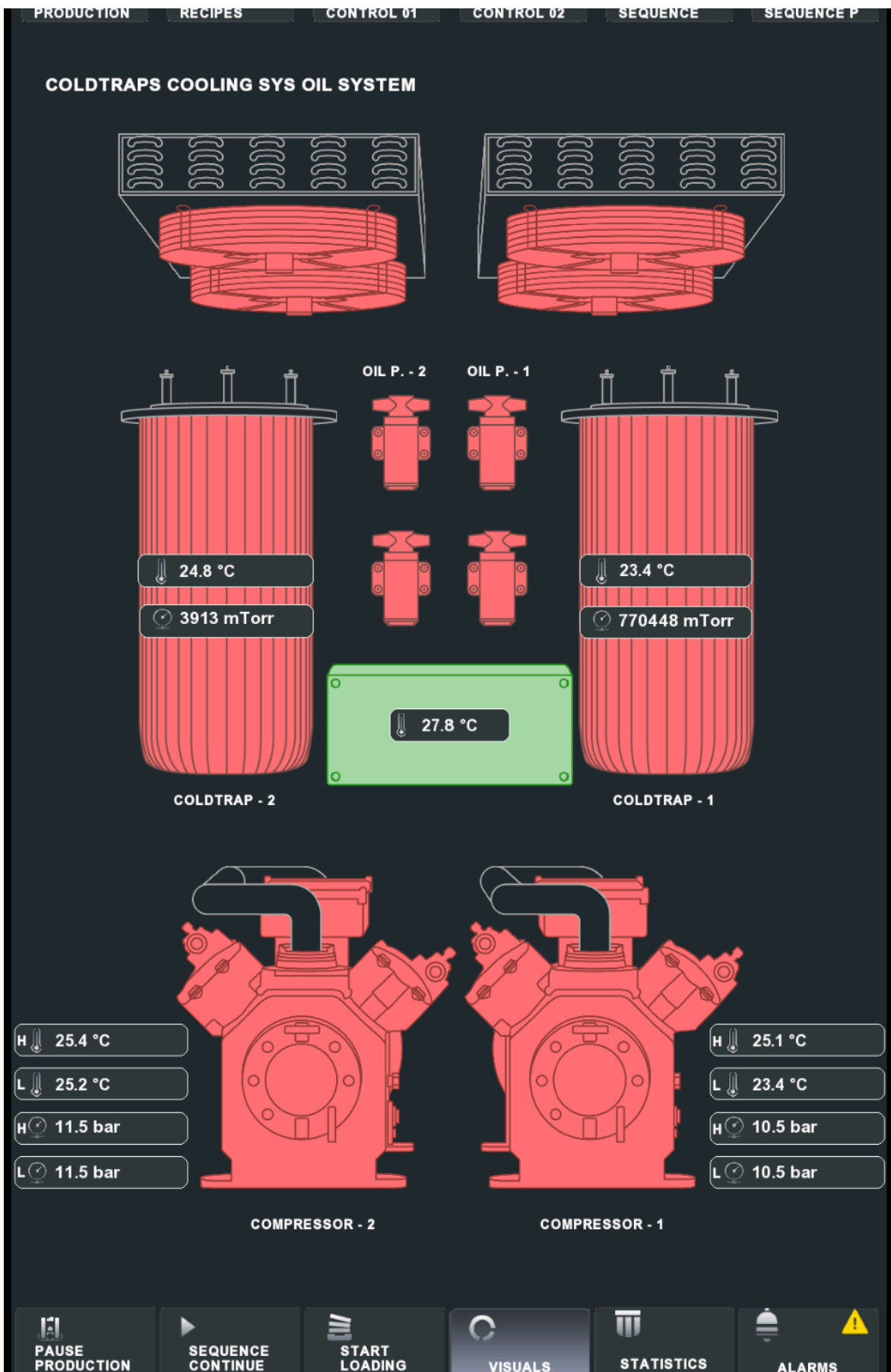
1. System Visualization

- The screen displays **two main compressors**:
 - **Compressor 1**
 - **Compressor 2**
 - **Cold Trap 1**
 - **Cold Trap 2**
 - **Coldtrap Pumps 1**
 - **Coldtrap Pumps 2**
- Each component is **highlighted in red or green**, indicating its status and connection points.

2. Real-Time Monitoring

Each section provides **live sensor data**, including:

- **Temperature (°C)** → Displays the current temperature of system components.
 - **Pressure (bar/mbar)** → Shows vacuum or system pressure readings.
 - **Cooling System Readings** → Indicates the temperature at different cooling stages.
-



Safety and Responsibility

Safety Guidelines & Operator Responsibility

The operator holds a crucial role in ensuring the safe operation of the machine, and specific responsibilities are outlined below:

1. **Age Restriction:** The operator must ensure that only individuals aged 18 or older operate the machine.
2. **Proper Training:** The operator must guarantee that machine operators have received appropriate training. They should be familiar with the machine's functions, aware of potential operational hazards, and have thoroughly read the provided operating instructions.
3. **First Aid Competency:** Operators must be capable of administering first aid measures in the event of an accident while operating the machine.
4. **Protective Gear:** All personnel operating the machine must be equipped with suitable protective clothing. Gloves, in particular, should be worn at all times during machine operation.
5. **Safety Assessment:** The working environment must be regularly assessed to identify potential accidents related to the freeze dryer's presence.
6. **Timely Maintenance:** Any components of the freeze dryer found to be in less than perfect condition should be replaced without delay to maintain safe and efficient operation.
7. **Accessible Instructions:** It's essential to keep the operating instructions in close proximity to the freeze dryer, ensuring quick access for reference.

By adhering to these safety guidelines and fulfilling the responsibilities outlined, the operator contributes significantly to maintaining a secure operational environment.

The danger stickers on the machine must be visible at all times and replaced if necessary.

Risks during Transport, Mounting, Commissioning and Operation



Dangers can arise during transport

Transportation can pose risks if the machine or its components are inadequately fastened or secured, potentially leading to movement or falling. For comprehensive guidance on this subject, please refer to the 'Transport and Storage' chapter.



Dangers can be caused by incorrect positioning

Ensure the machine is positioned for easy access to all its areas, while maintaining a minimum safety clearance of at least 30 cm, ensuring ample space around the machine.



Caution Regarding the Door

Avoid applying any force or weight to the machine's door, such as leaning on it, opening it abruptly, or slamming it shut. Always ensure that the door remains clear of contact with your feet or any other part of your body.

It's essential to be cautious around the plexiglass door, as it features sharp edges and corners that could potentially cause injuries or cuts.



Dangers from the fan of the compressor

Make sure not to touch the fan of the compressor unit, positioned on top of the machine above the compressors, located in the back unit of the machine.



Dangers can be created by incorrect connection to the power source

Failure to correctly connect electronic components may result in injuries. Ensure that no liquids enter the electronic area of the machine. Any work on the power supply system should be performed exclusively by licensed professionals. Regularly inspect the electronic system for functionality, and promptly replace any loose or burnt cables.



Ensure a precise alignment between the local voltage and the nominal voltage, as indicated on the type plate.



Ensure a consistent and stable electrical supply with minimal voltage fluctuations in the machine's operating area. If the current is not steady, consider implementing external current stabilizers for all phases compatible with the machine's power requirements.

Be aware of the potential risk of electric shock when handling live components. In case of an electric shock, seek immediate medical attention and consult a doctor without delay.



Danger from the cooling system

Frostbite risk exists when handling the cooling system. Always wear protective gloves, and refrain from touching the cooling system before, during, or after a freeze-dry cycle of the machine.



Danger from the refrigerant

Be aware of the potential risk of refrigerant poisoning when the air's concentration reaches unsafe levels. Only individuals with specialized training in coolant handling should perform any work on the cooling system. Additionally, exercise caution to prevent any movement or damage to the cooling system during machine operations, such as moving, opening, or closing. Furthermore, ensure that the room housing the machine is adequately ventilated to maintain a safe environment.



Danger from dangerous dry goods

Take precautions against potential poisoning or infections that may result from hazardous or toxic substances leaking from the dry goods. Shield yourself and your personnel from any contact with such substances while unloading and cleaning the machine, and adhere to necessary decontamination protocols.

Avoid the use of solvents containing explosive gaseous mixtures or acids to prevent the risk of injury.

Furthermore, be mindful that certain chemicals have the potential to etch or cause severe damage to various materials in the machine or vacuum pump, such as metals, acrylic, PTFE, viton, nitrile, rubber, silicone, and gaskets. It's advisable to have a trained chemist evaluate the risk of damage and determine the appropriate program based on the boiling point under vacuum for each enclosed chemical before operating the machine.

When working with chemicals, be alert to the possibility of vapors entering the vacuum pump and being released into the same room.

There is a risk of toxic extraction water. Ensure that it is disposed of in an environmentally friendly manner and cannot become a hazard to the operating personnel.



Danger due to hot surfaces

Be cautious of the elevated surface temperatures of the machine after the drying stage, which can lead to burns if touched.

This includes the drawers within the machine, the exposed pipes of the cooling system, certain components of the compressor, and even the surface of the vacuum pump, all of which may become very hot.



Danger from cold surfaces

Beware of the risk of extreme cold on the machine's surfaces during and after operation, as it can lead to frostbite if touched. Notably, the vacuum chamber, drawers, components at the rear of the machine (such as connectors), and the cooling system's piping may become extremely cold.



Danger due to a vacuum that has built up or is building up

Severe injuries may result from contact with openings during vacuum buildup or when a vacuum has already been established. These openings can create suction forces due to temperature differences. Be especially cautious around the front door and any openings where body parts could become entangled.

Avoid proximity to valves with limbs, such as the evacuation valve, which can open and close automatically, presenting a significant danger.

In case of uncertainty about injury management, promptly call for an ambulance.

Additionally, remember to replace the front machine seal (blue seal ring) annually.



General safety rules

Refrain from leaning on or attempting to move the machine while it's in operation. If you encounter any malfunctions or detect unusual odors like burning materials or suspicious sounds, cease the machine's operation promptly.

Under no circumstances should you operate the machine if there is any damage to the plexiglas door, including cracks or dents, as this poses a risk of implosion.

	To disconnect the power connection, ensure the machine's power connection control switch is set to the "0" or "Off" position.
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Maintenance & Cleaning

The manufacturer cannot be held responsible for damages resulting from improper use or maintenance.

When transitioning to a different product, ensure thorough cleaning of the freeze dryer using soap or mild detergents, and make sure to clean it only when it is switched off.

For disinfection of the inner chamber, you may use diluted ethanol, isopropyl alcohol, or diluted hydrogen peroxide. Never employ aggressive chemicals like acetone, bleach, nitro, carbon tetrachloride, chlorine, petrol, or similar substances.

It's vital to avoid contact between alcohol and ethanol (in liquid or vapor form) with the acrylic door, as this can cause permanent damage, reduce transparency, and create small cracks that serve as breeding grounds for bacteria.

Regularly inspect the freeze dryer's general condition to promptly identify and address any potential issues, including:

- Leaks
- Corrosion
- Bent, dented, or cracked materials
- Loose or exposed cables
- Accumulated dirt
- Open components

Vacuum Pump

For comprehensive maintenance and safety guidelines pertaining to the operation of the pump, we recommend consulting the pump instruction manual.

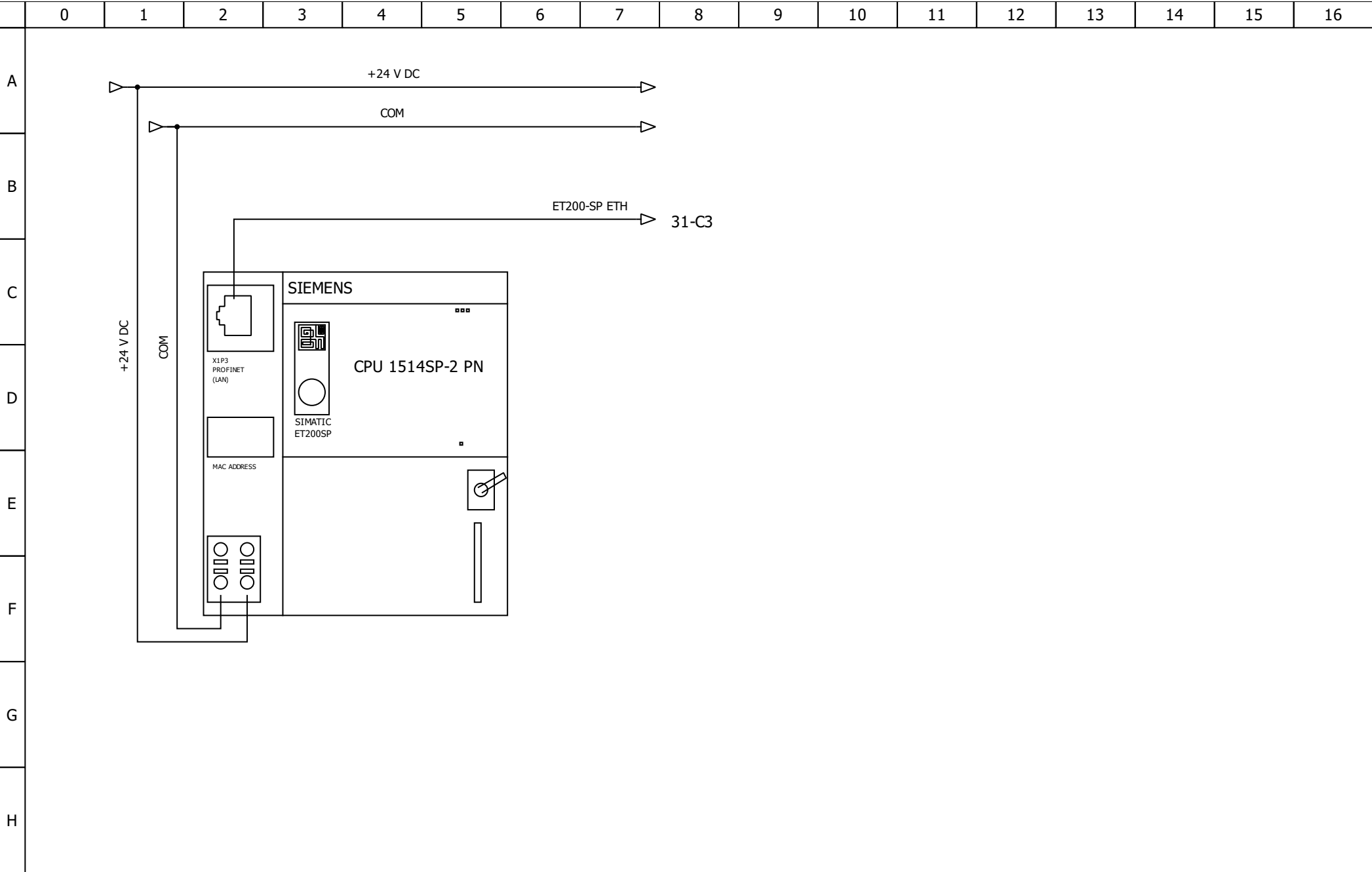
When the oil becomes visibly contaminated, consider changing it promptly. In specific cases, this may be necessary after each drying cycle for certain products. It's advisable to perform the oil change while the pump is still warm for optimal results.

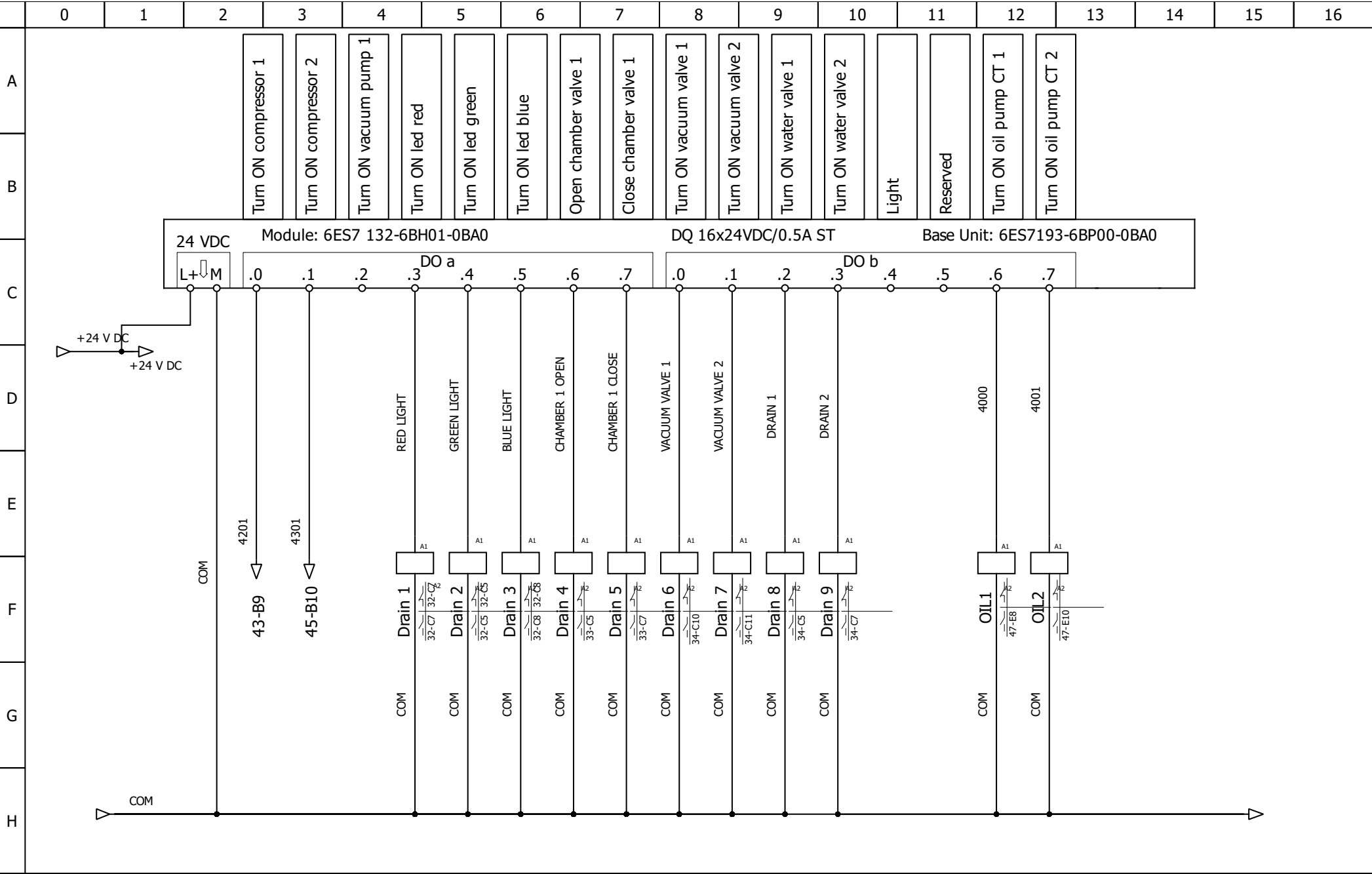
Cooling System

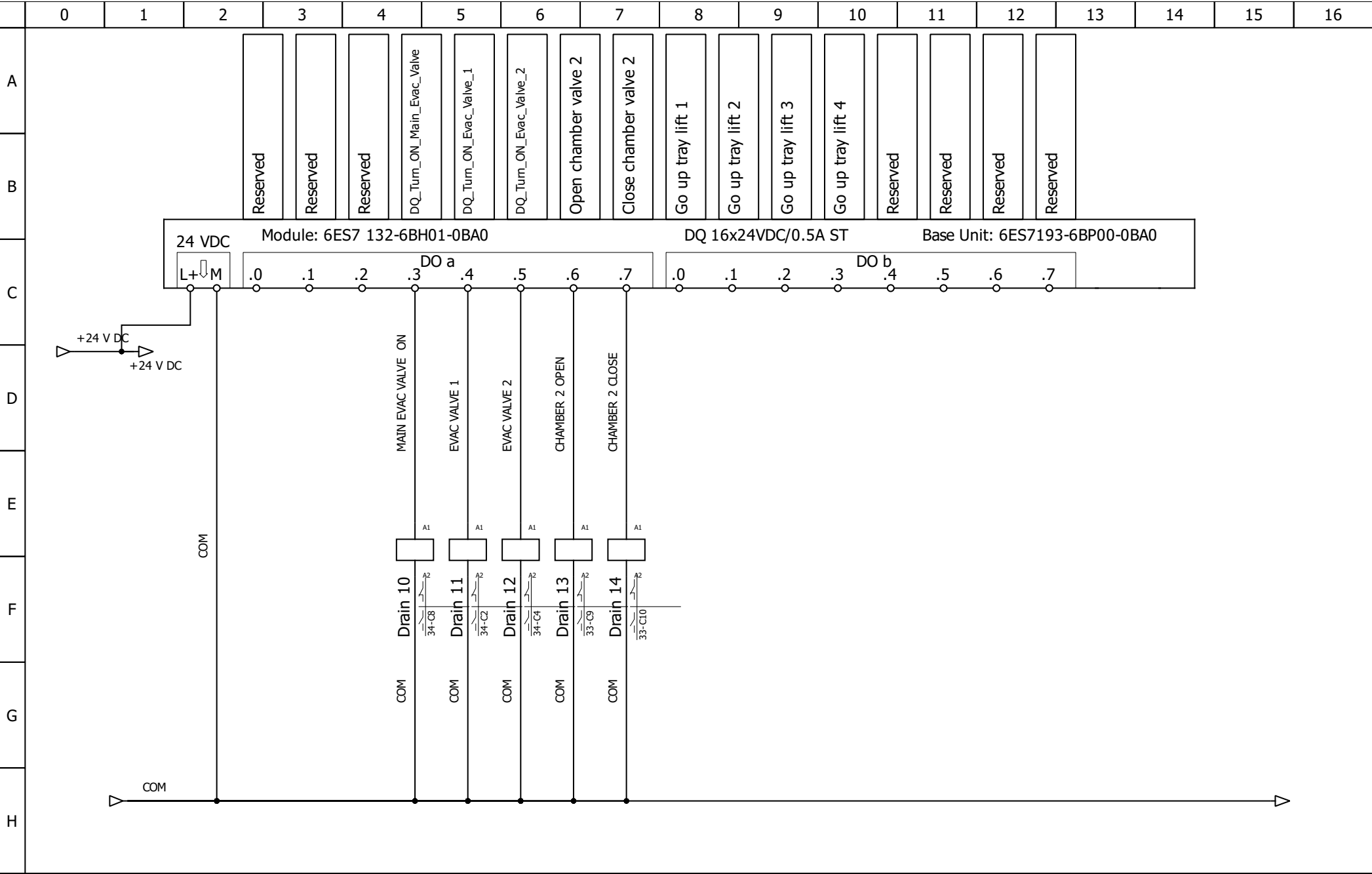
For in-depth maintenance insights and safety guidelines during operation, kindly review the pump's operating instructions. Additionally, please ensure compliance with national regulations governing the handling of cooling systems.

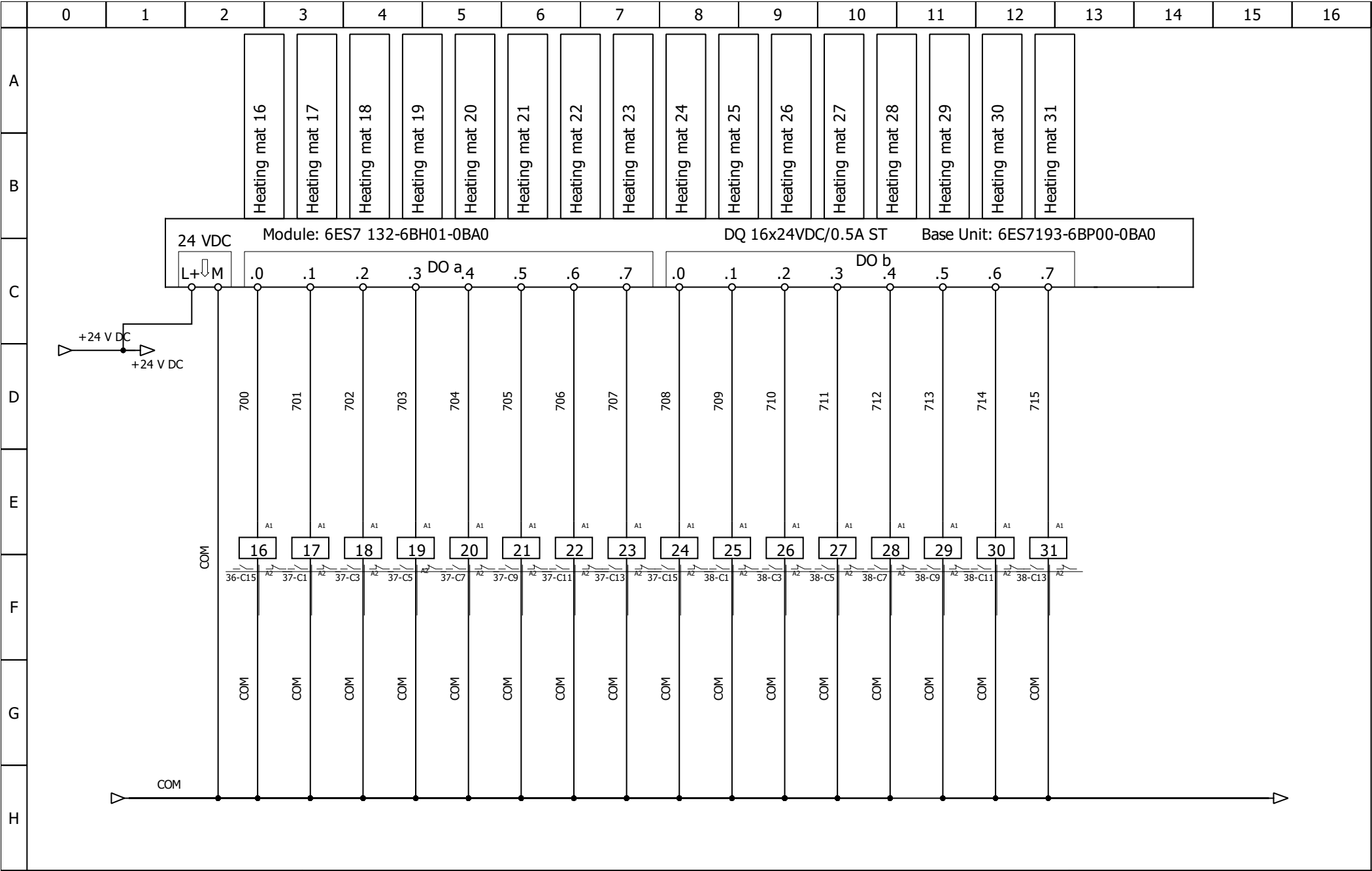
Electrical System Diagram and Wiring for IC570MAX

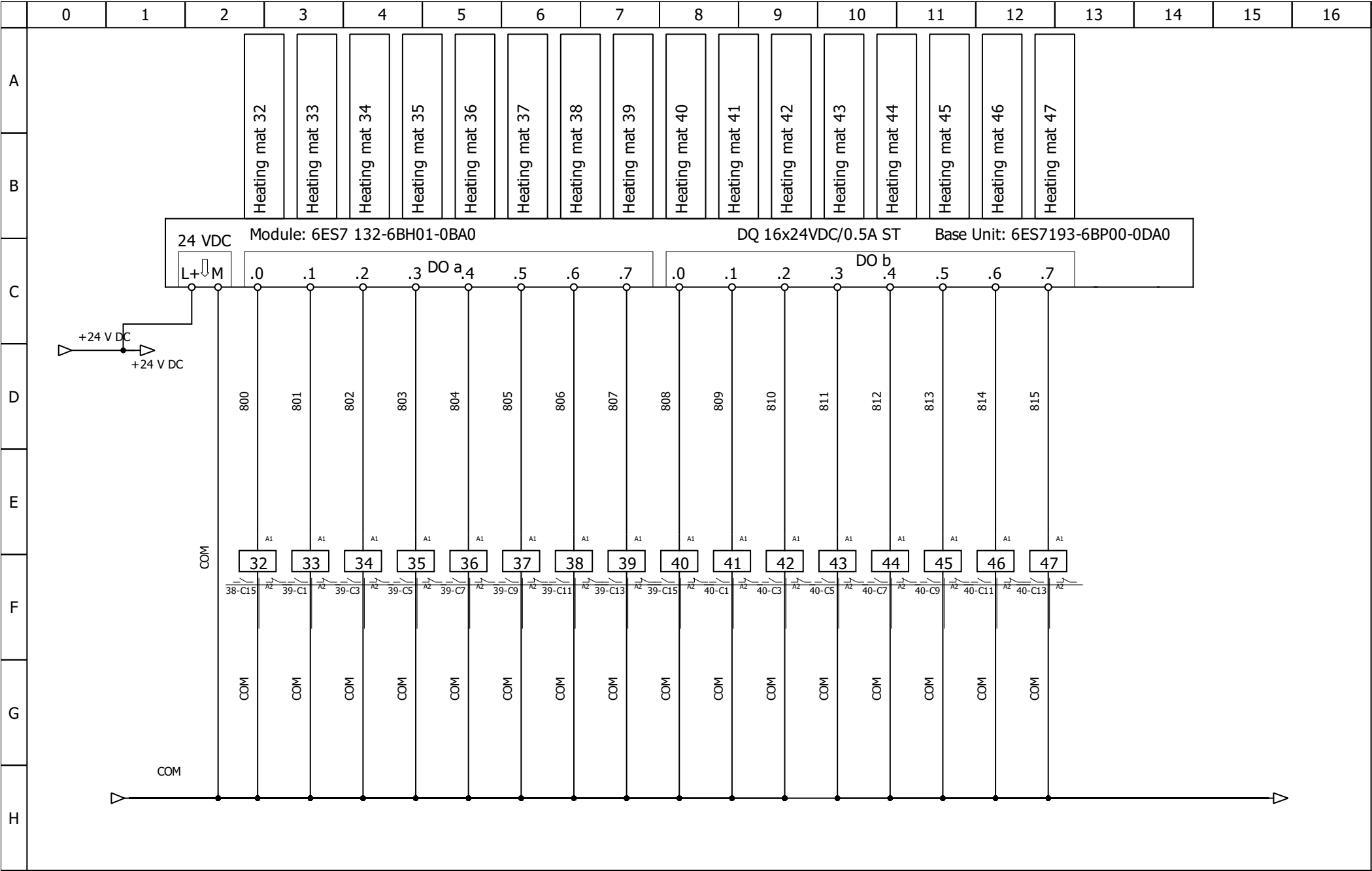
(The wiring may vary depending on the machine configuration)

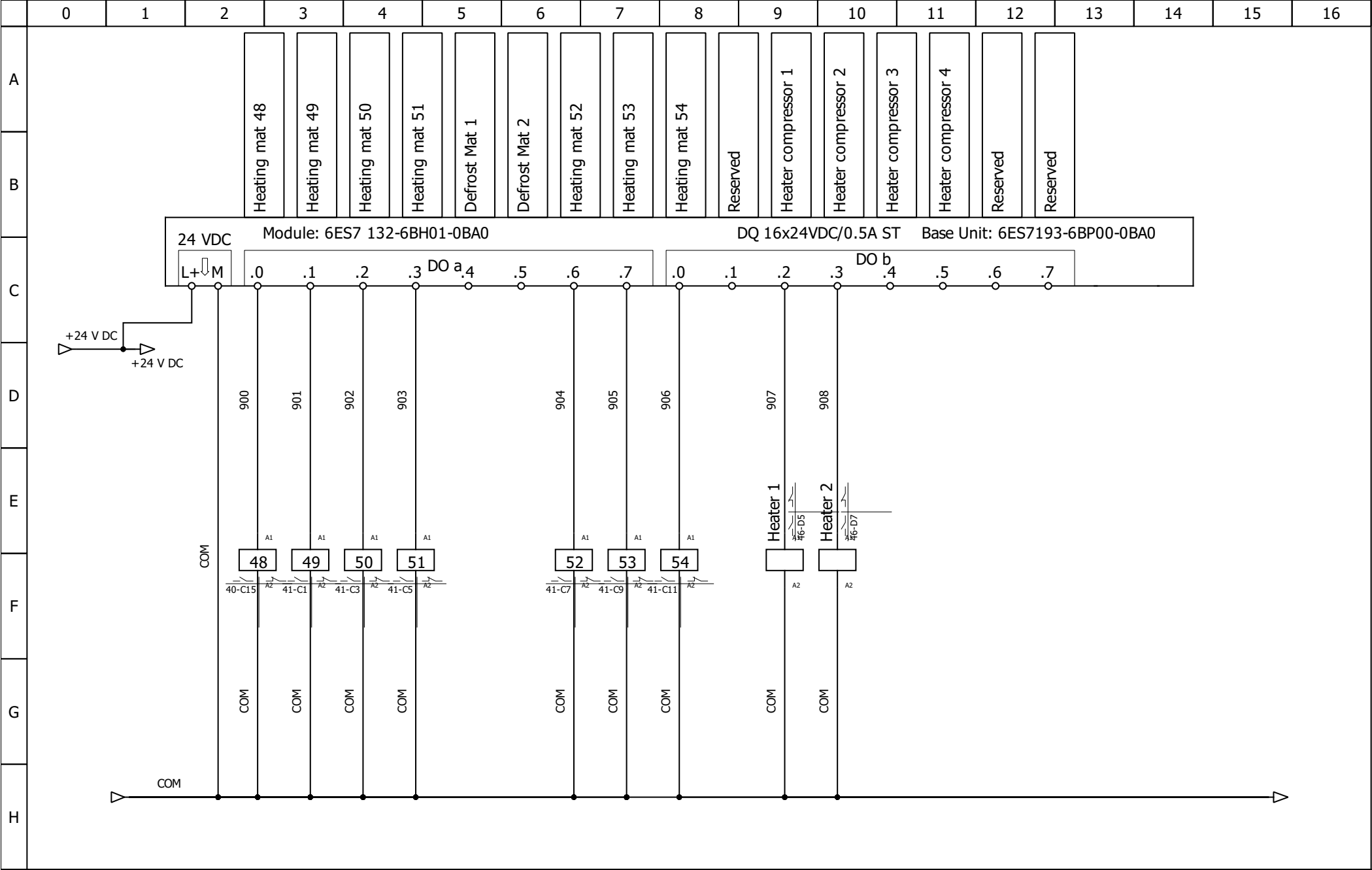


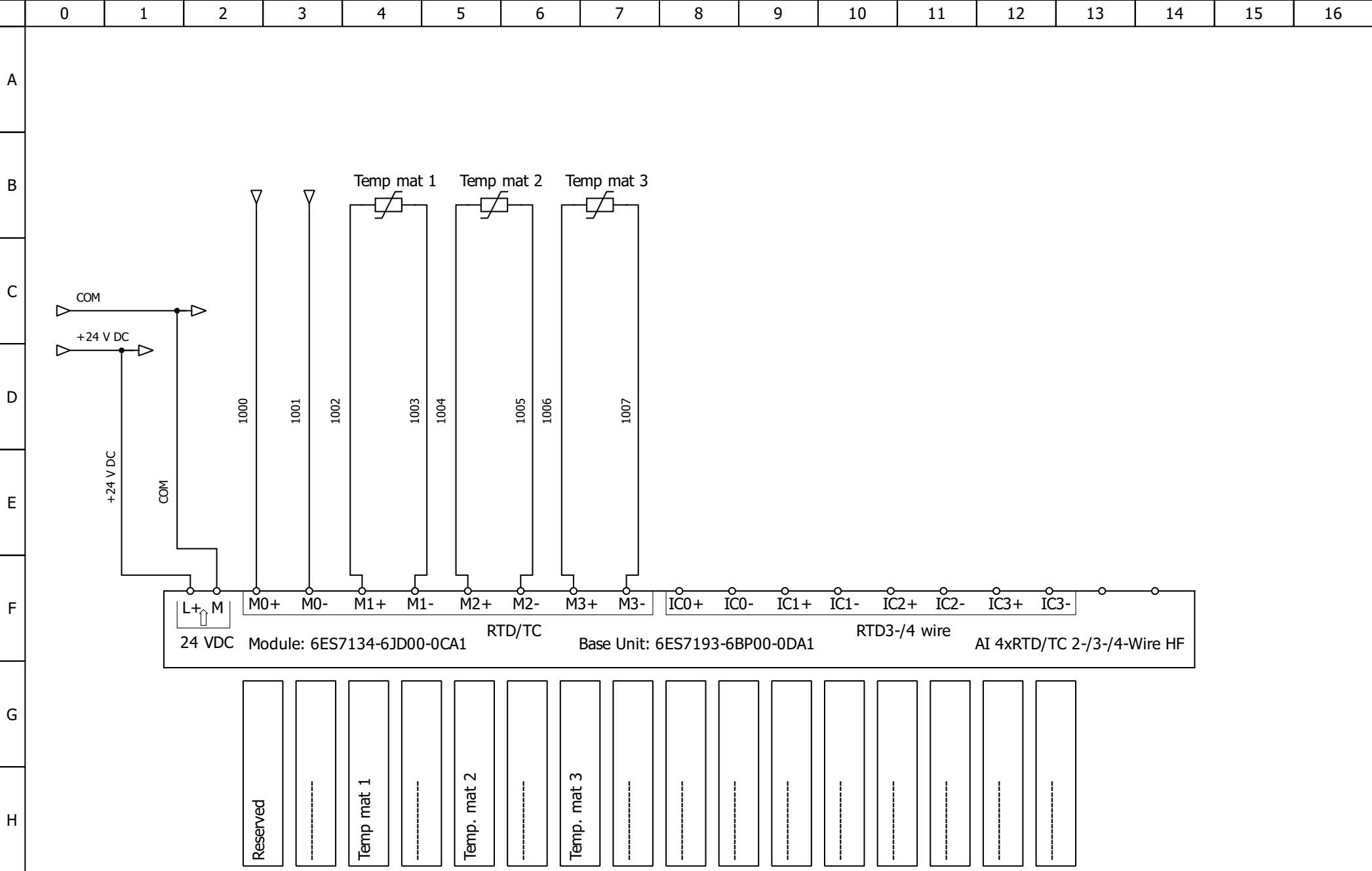


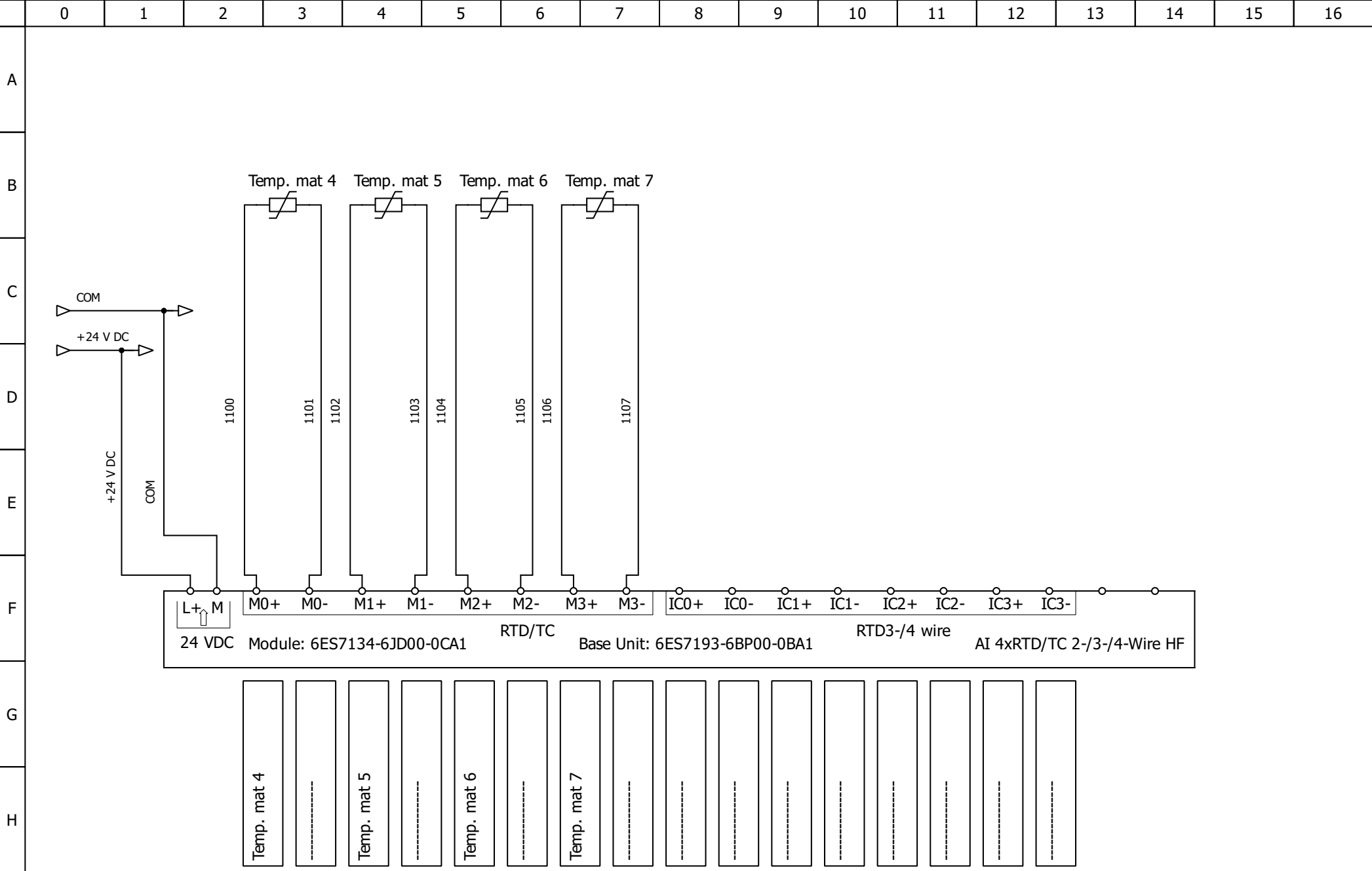


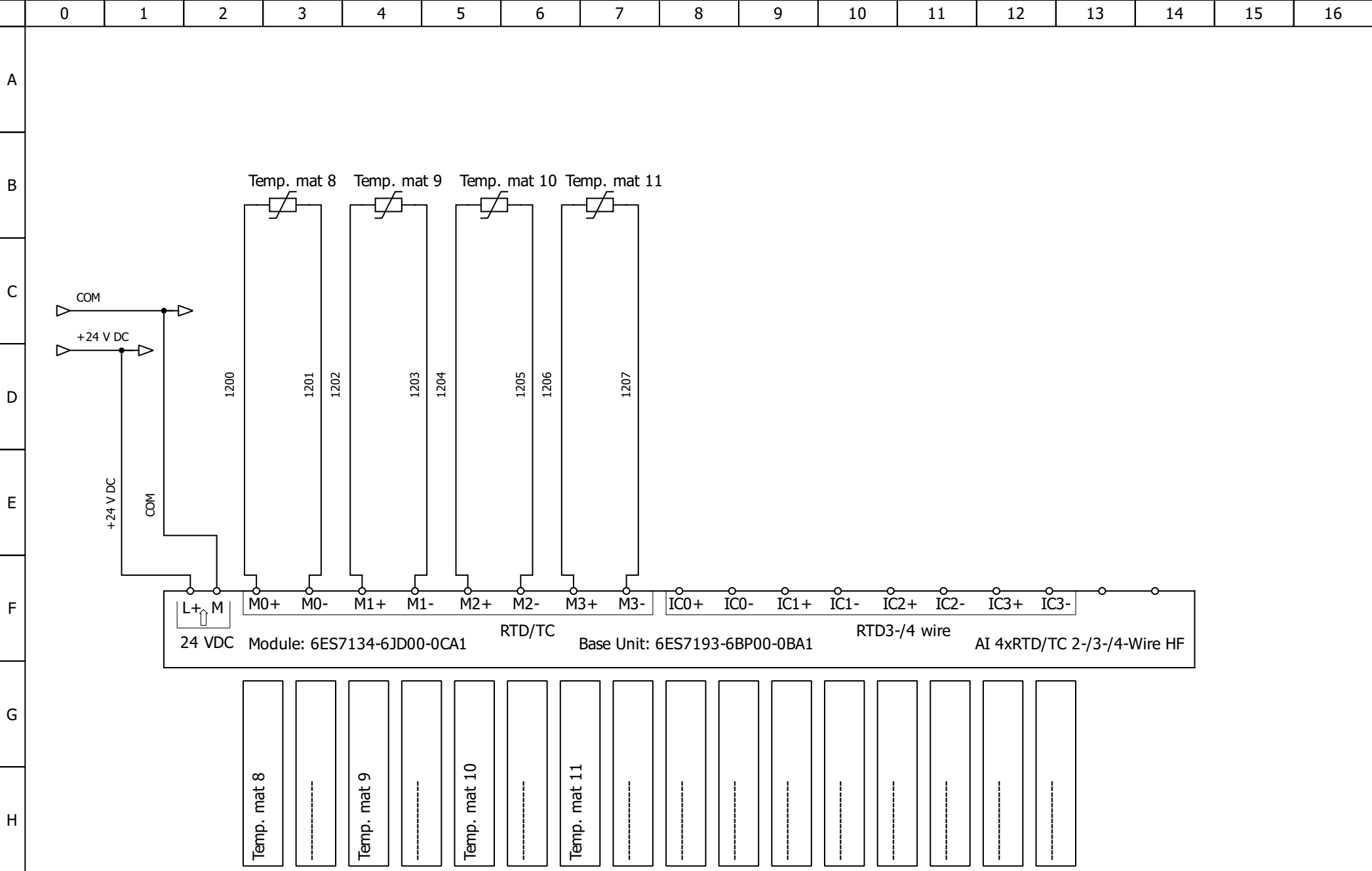


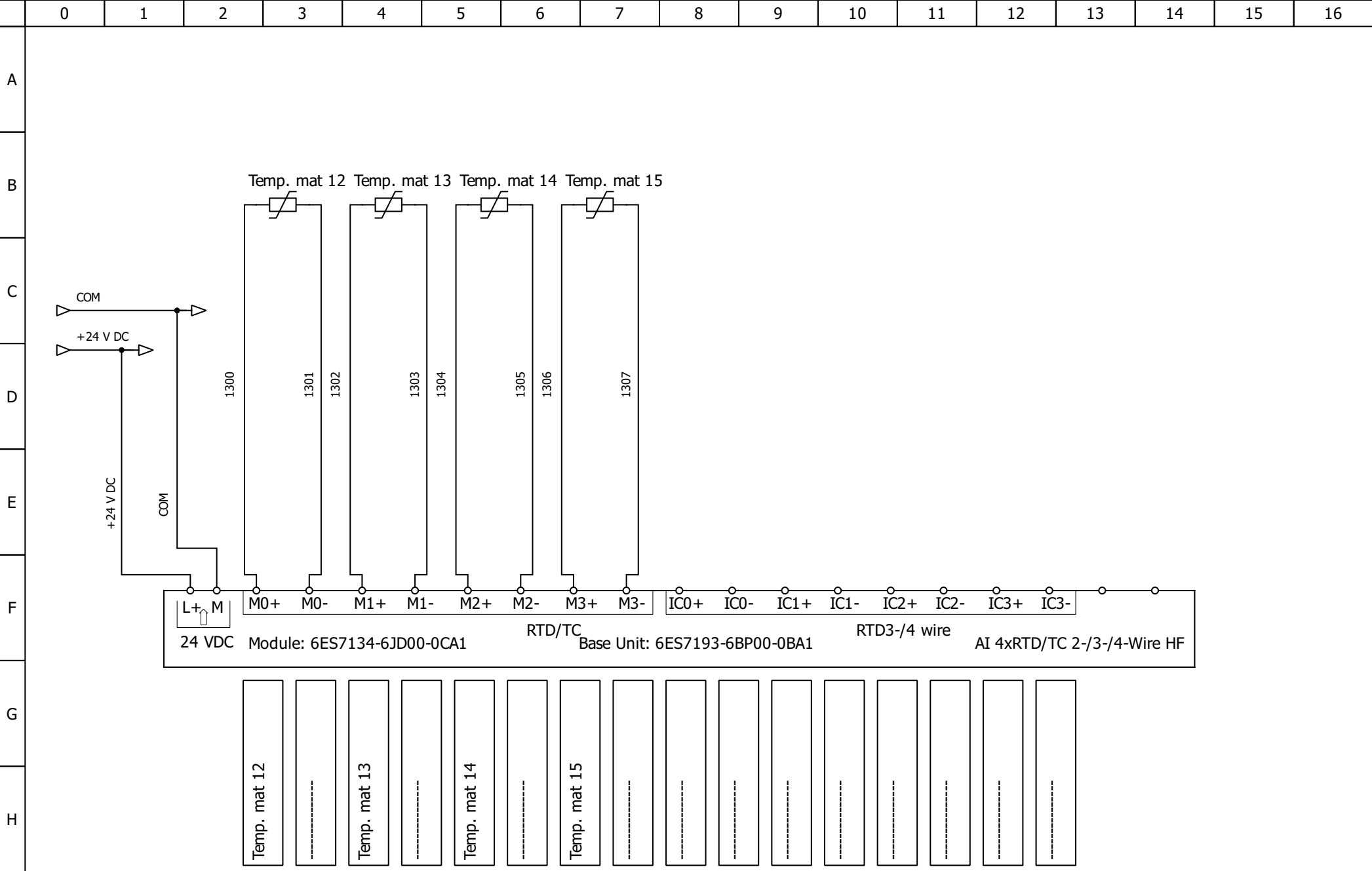


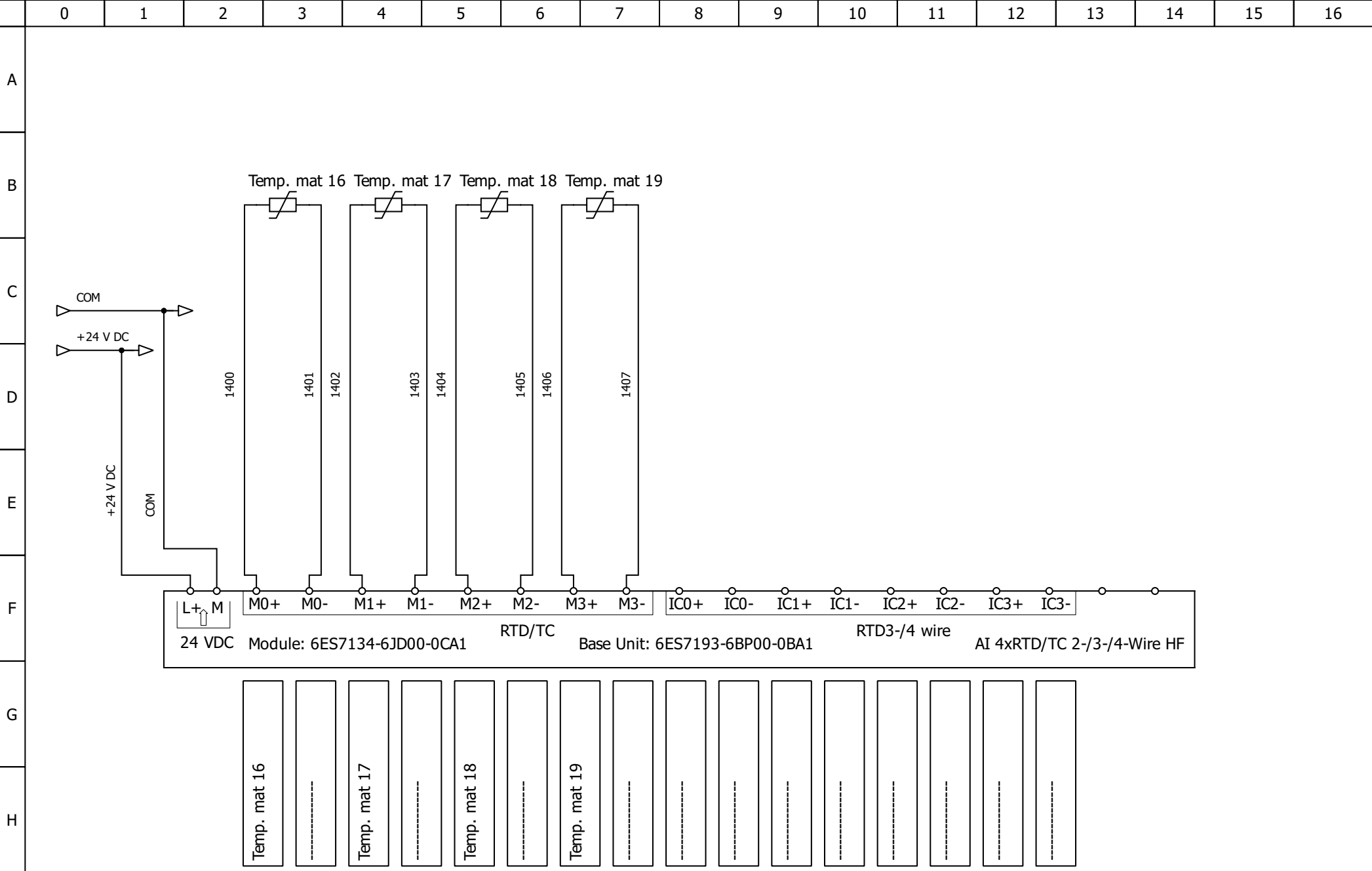


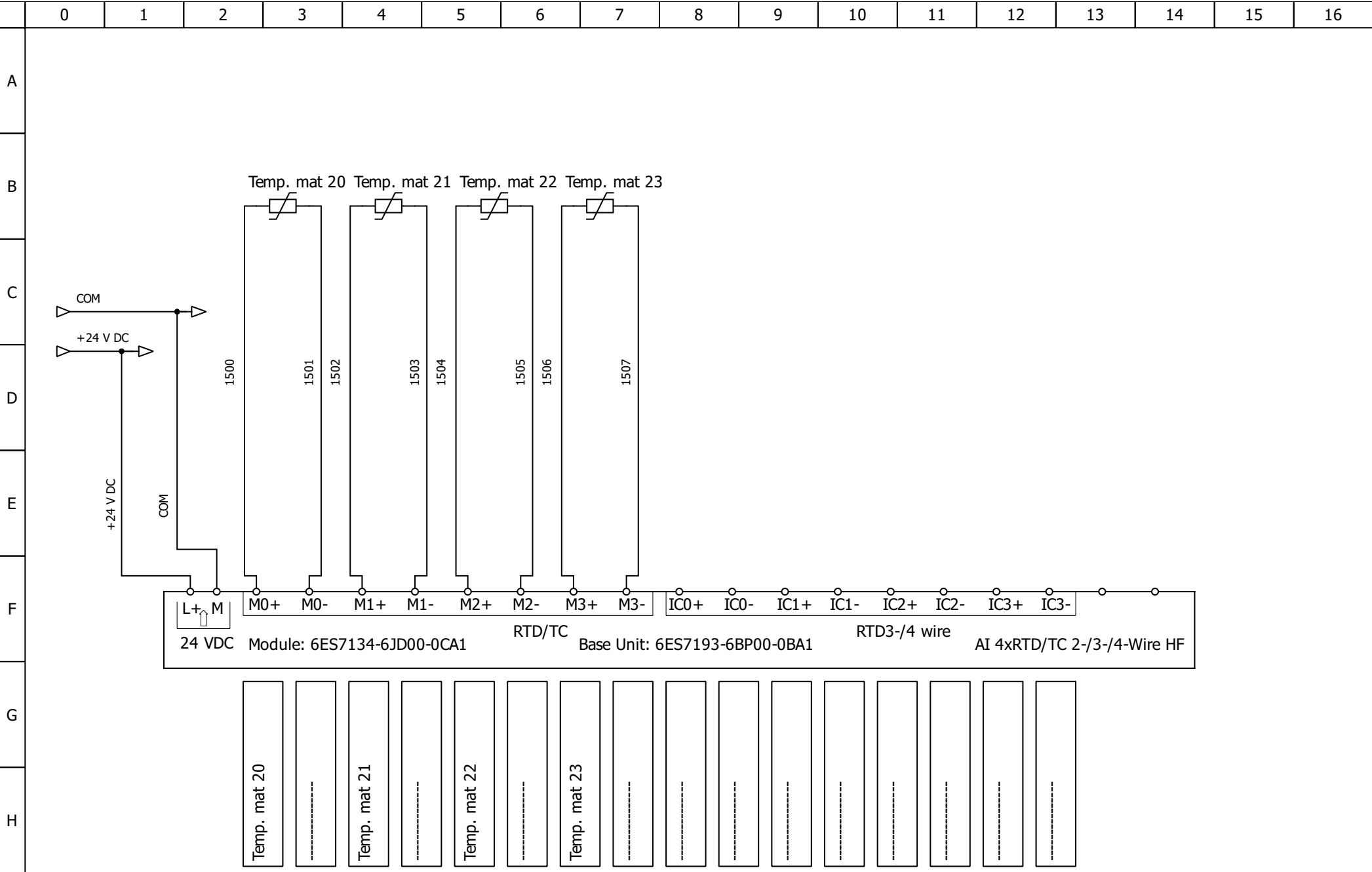


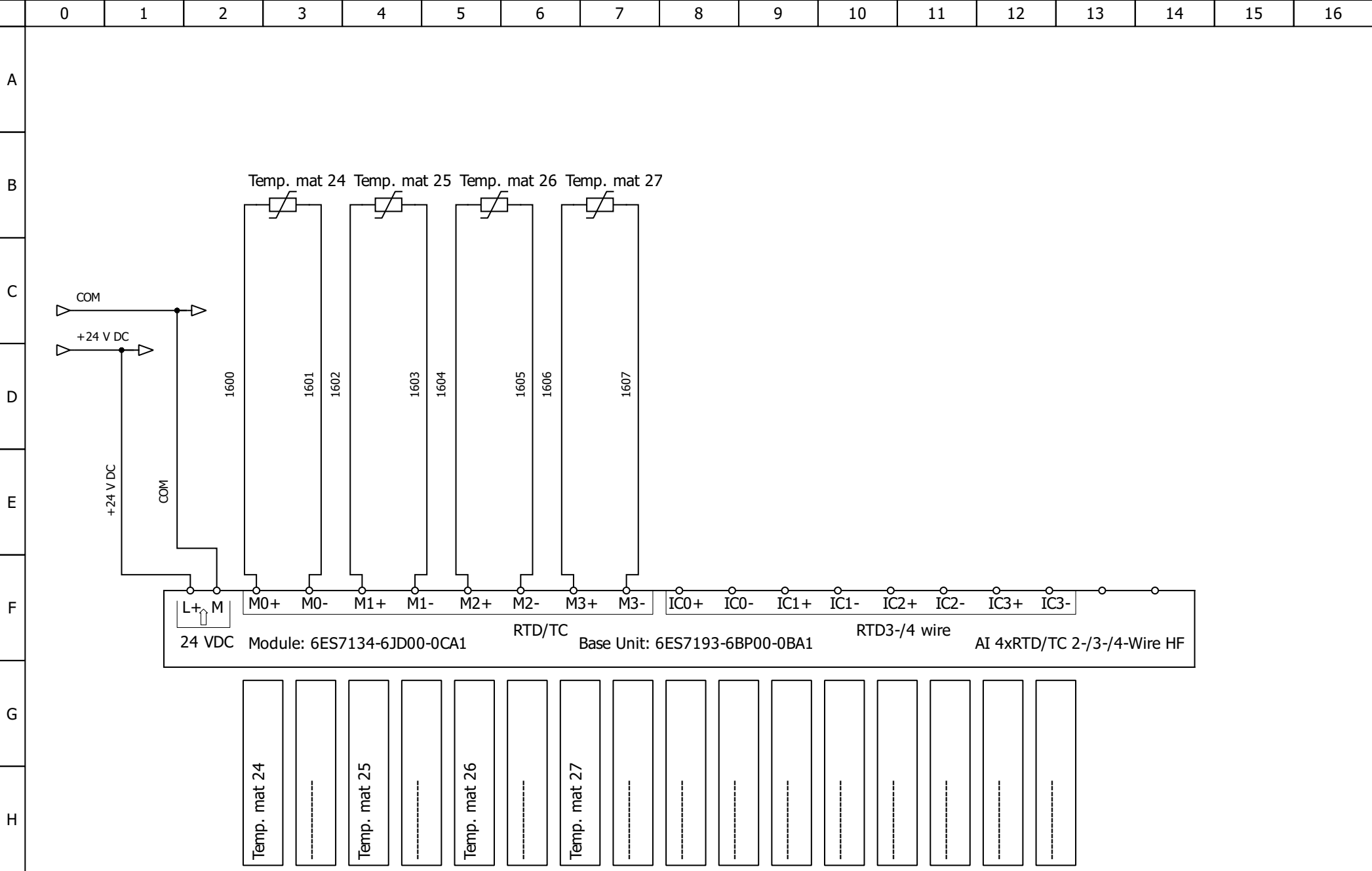


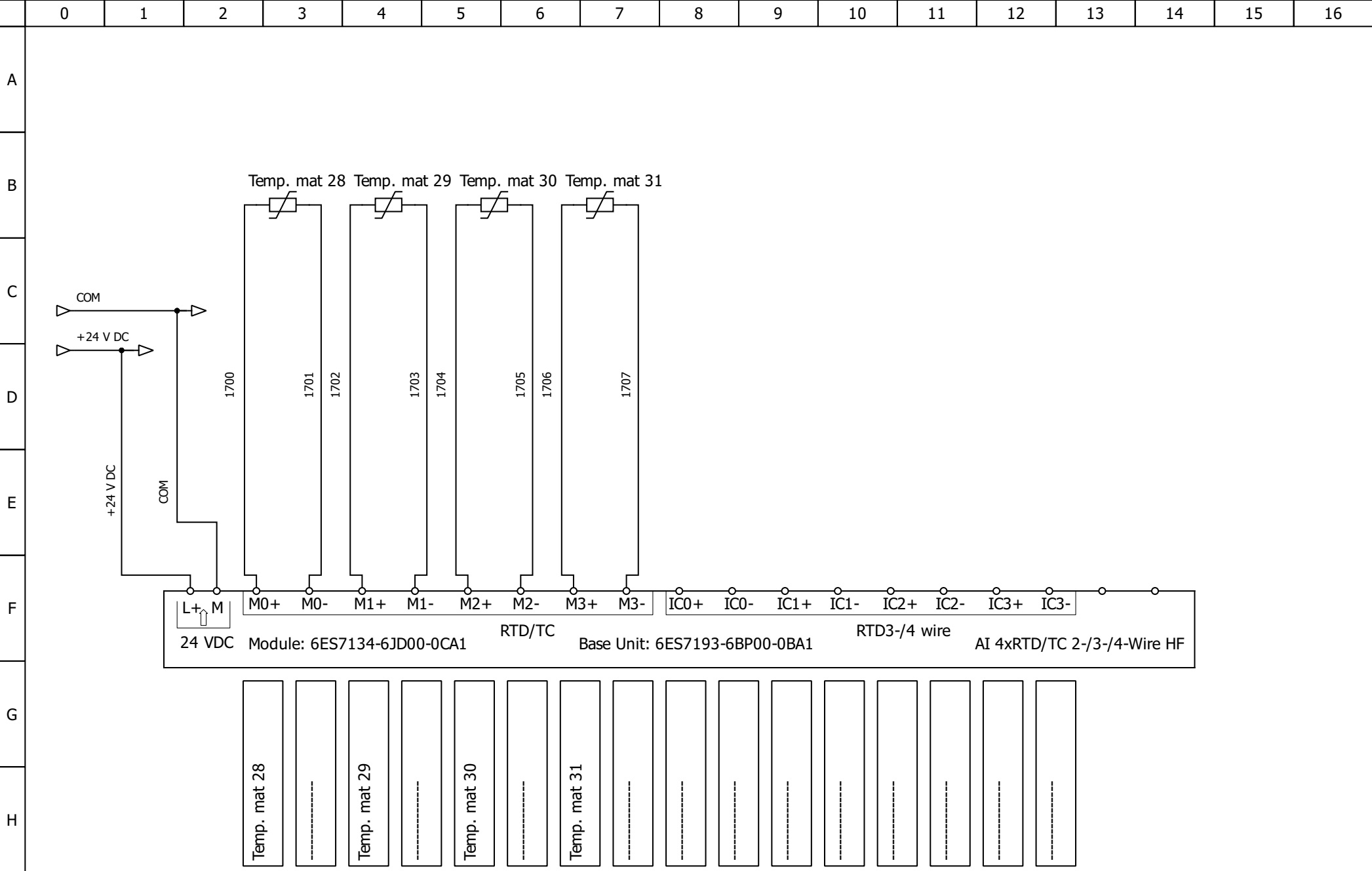


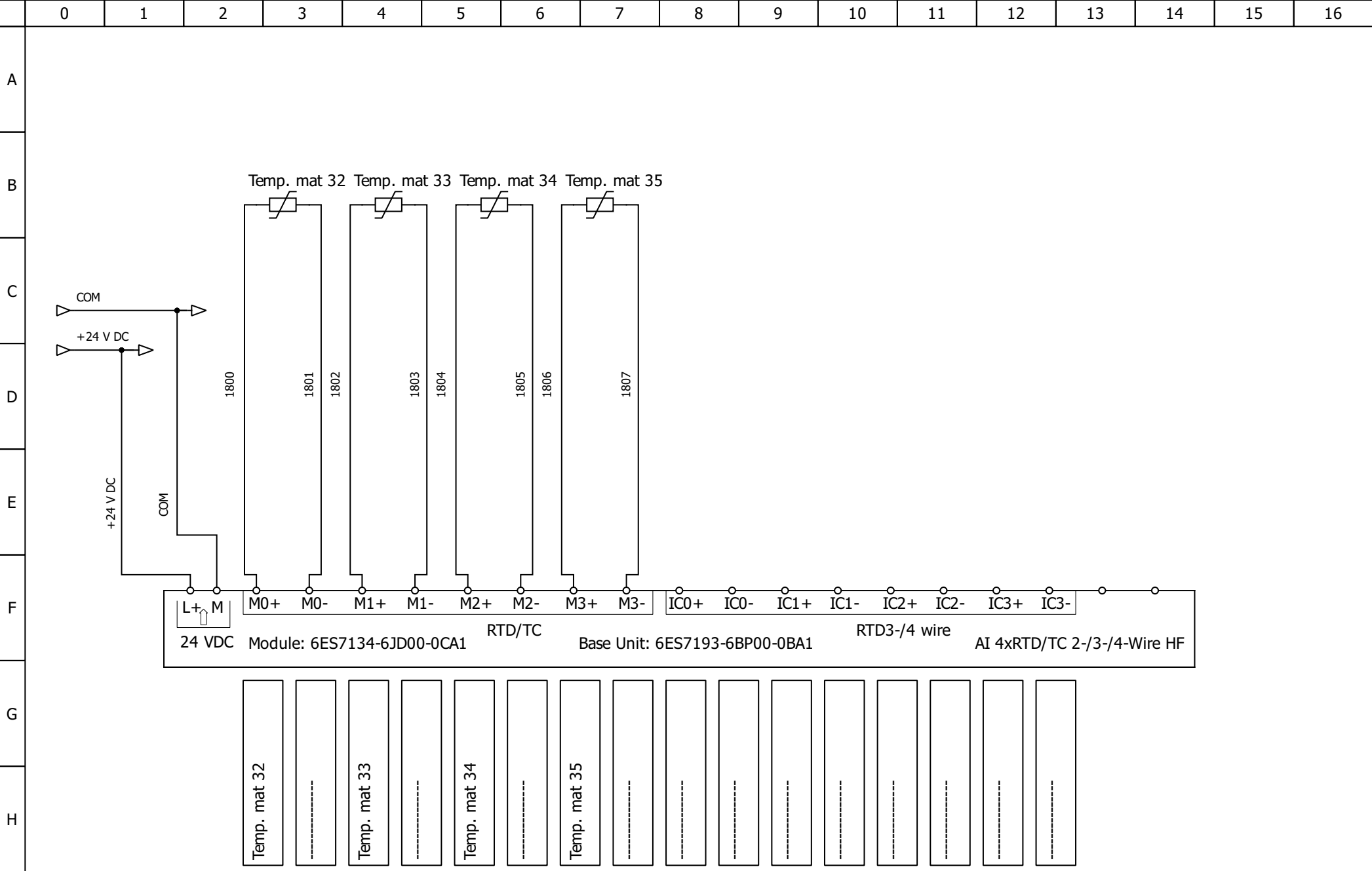


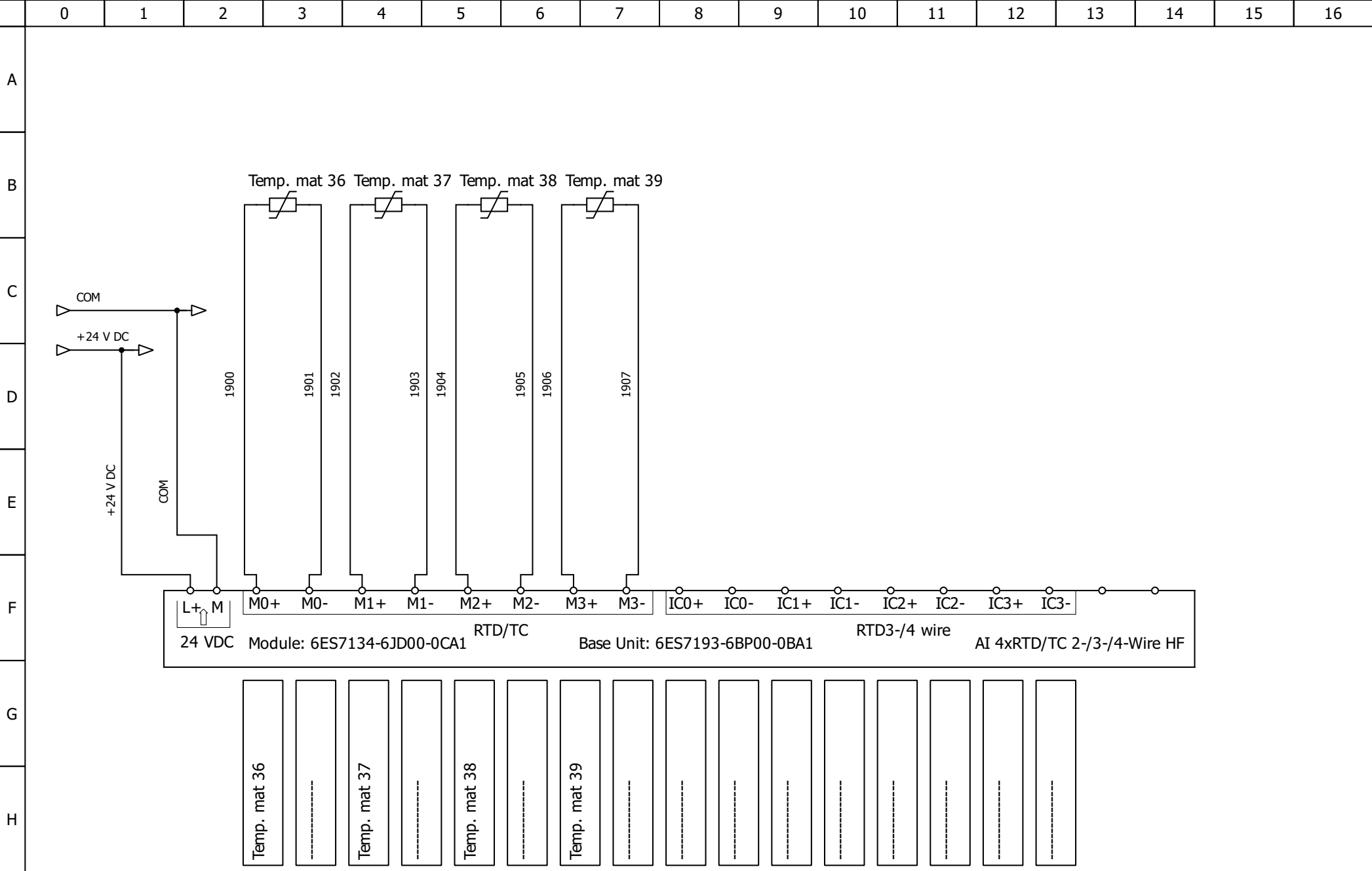










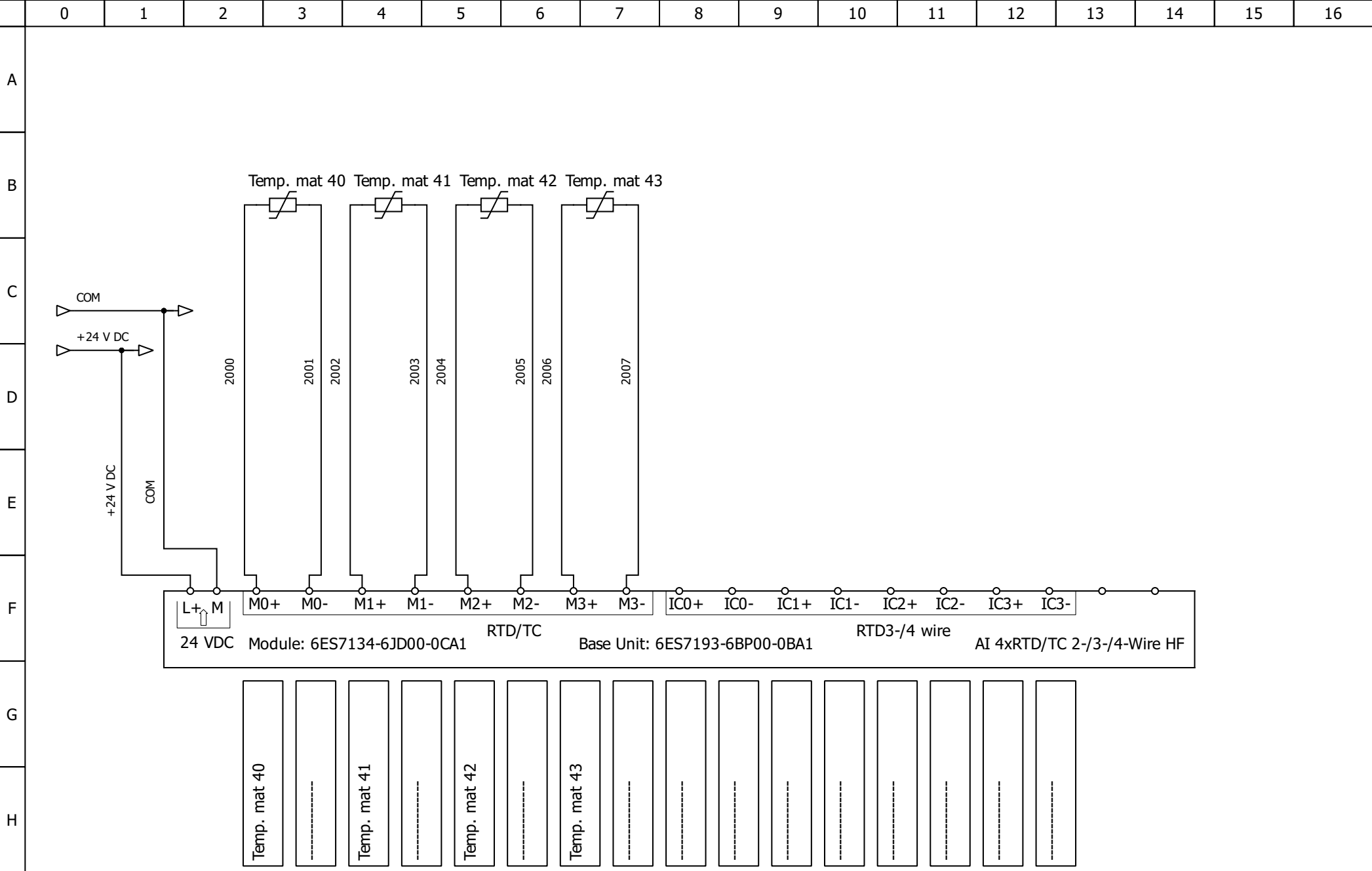


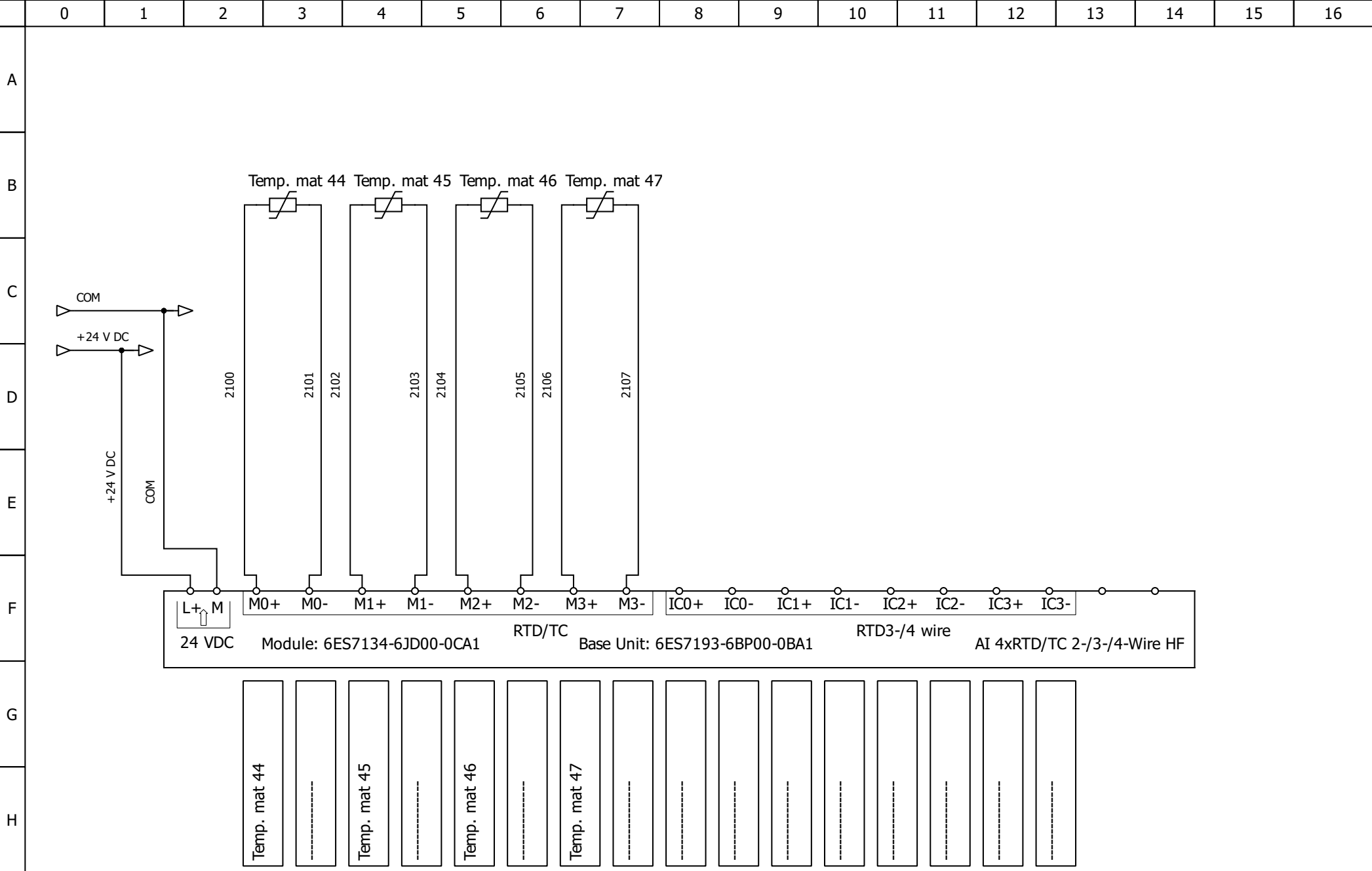
Temp. mat 36

Temp. mat 37

Temp. mat 38

Temp. mat 39





24 VDC

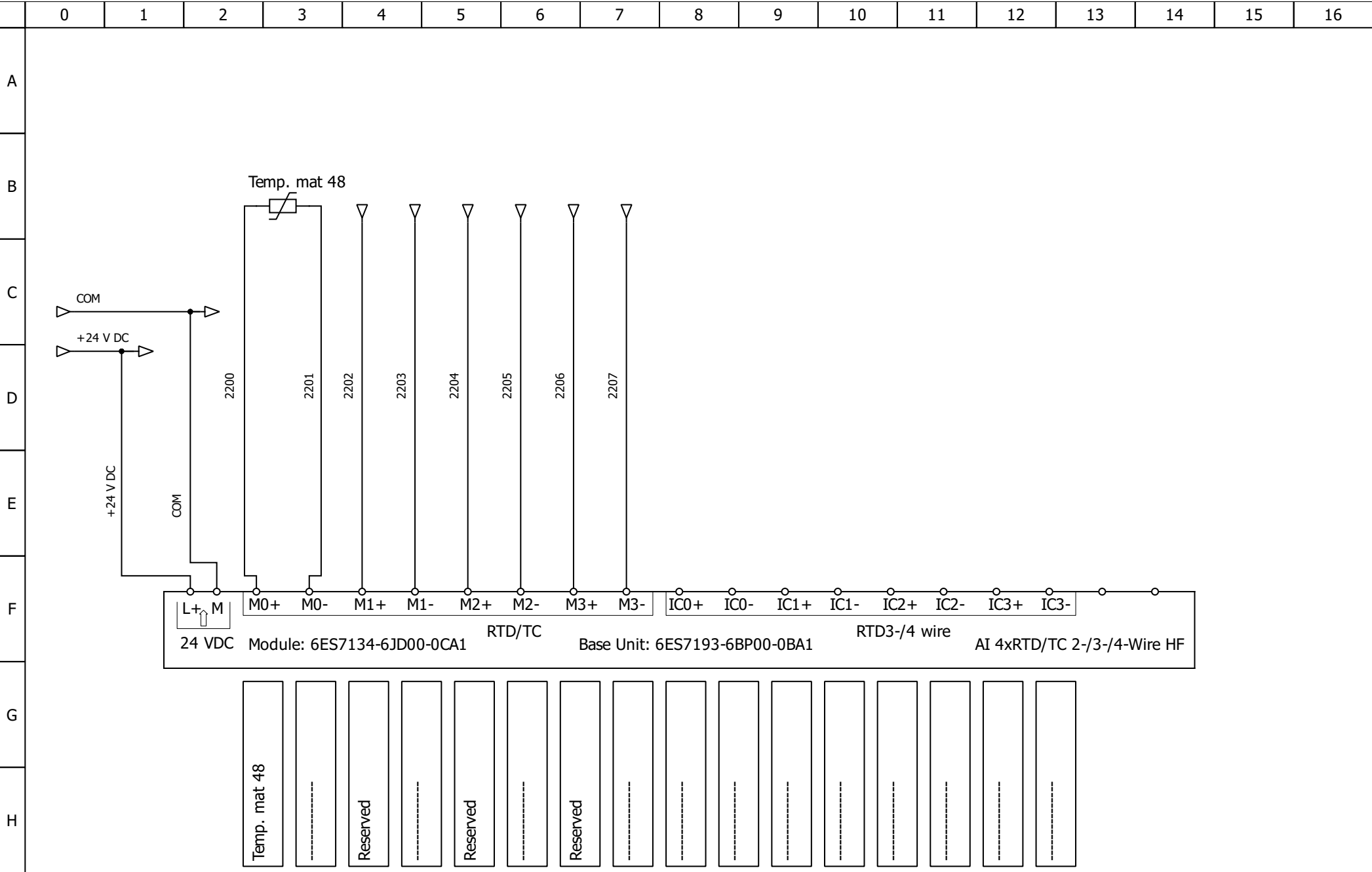
Module: 6ES7134-6JD00-0CA1

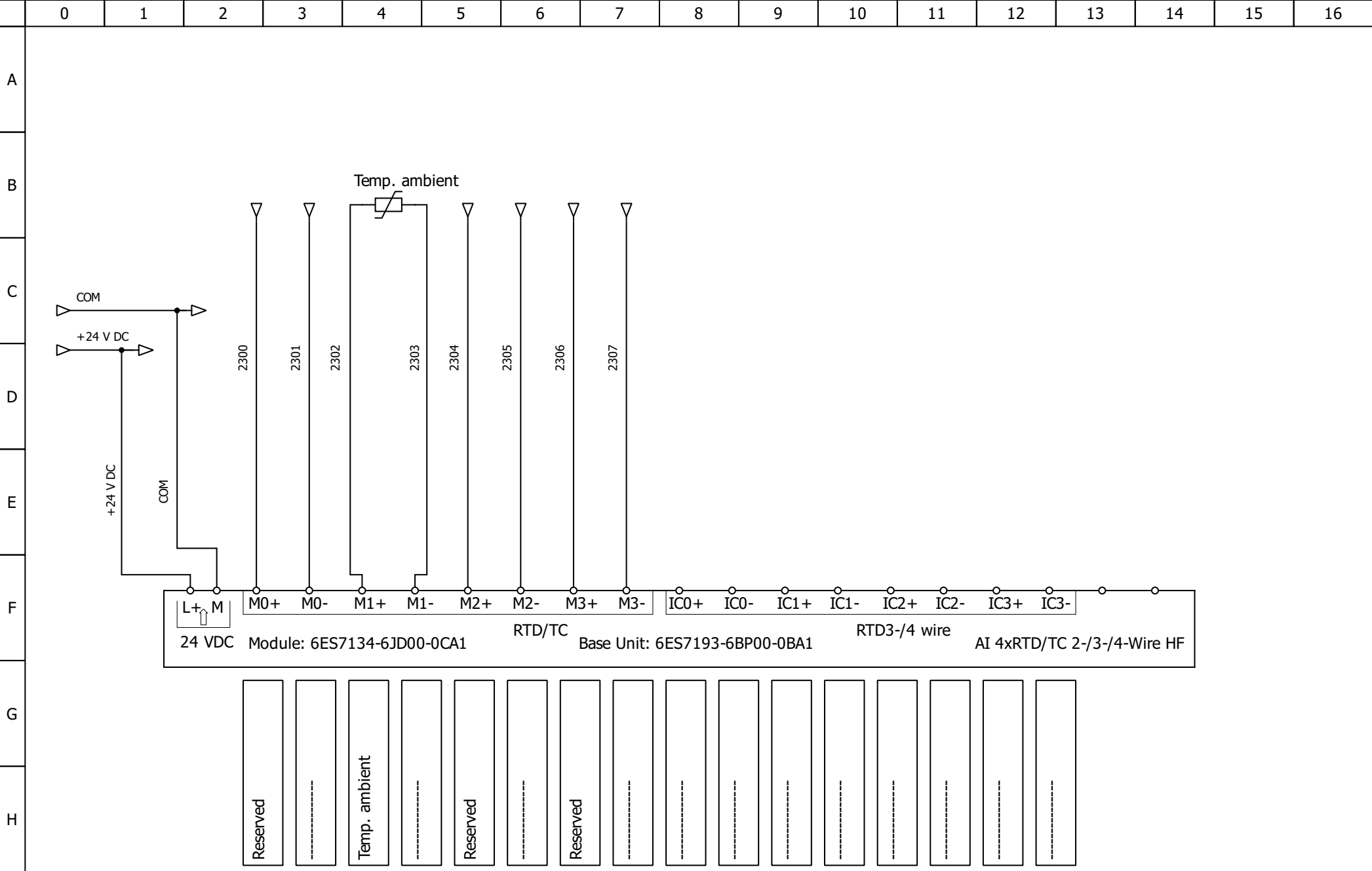
RTD/TC

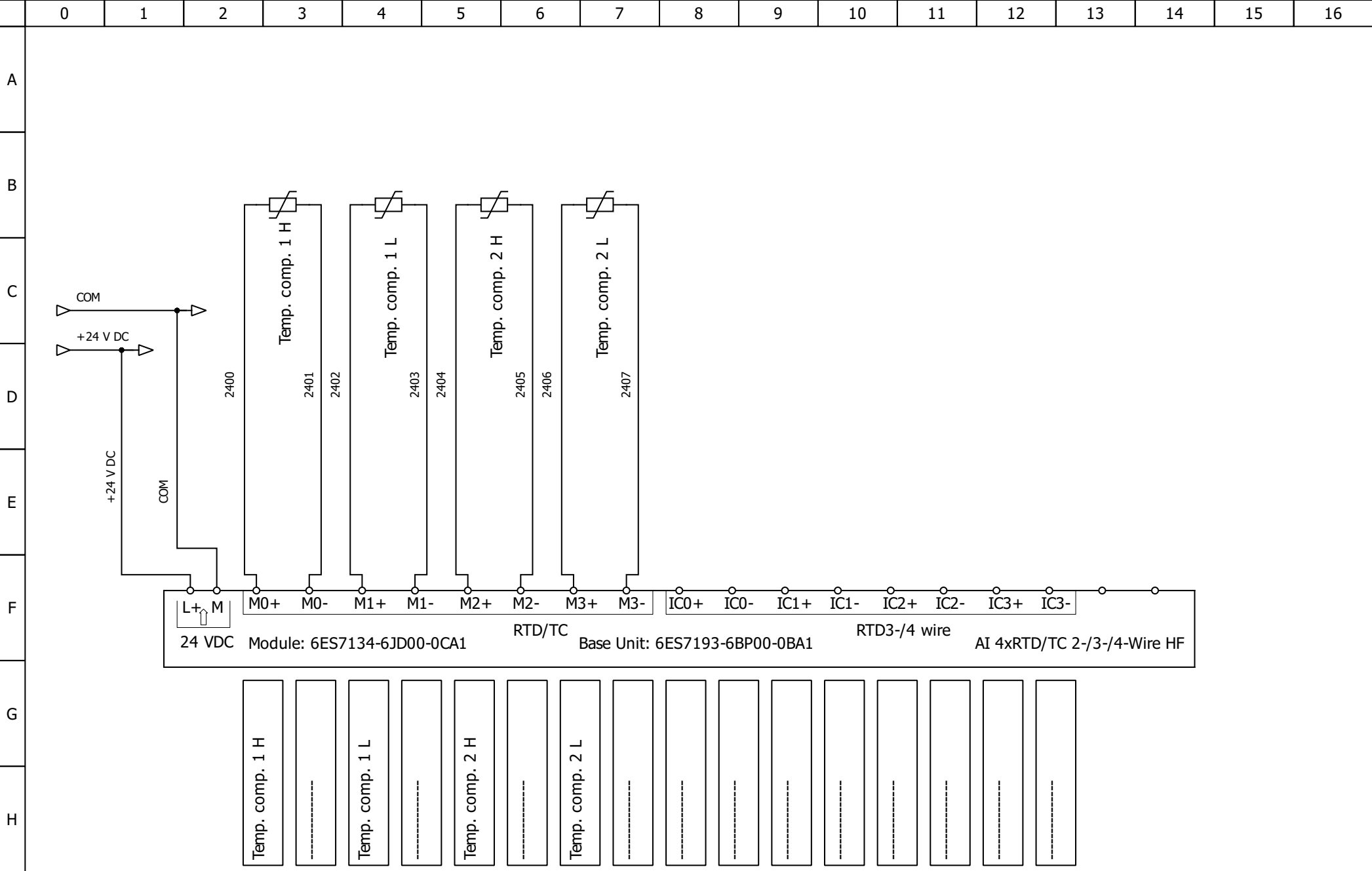
Base Unit: 6ES7193-6BP00-0BA1

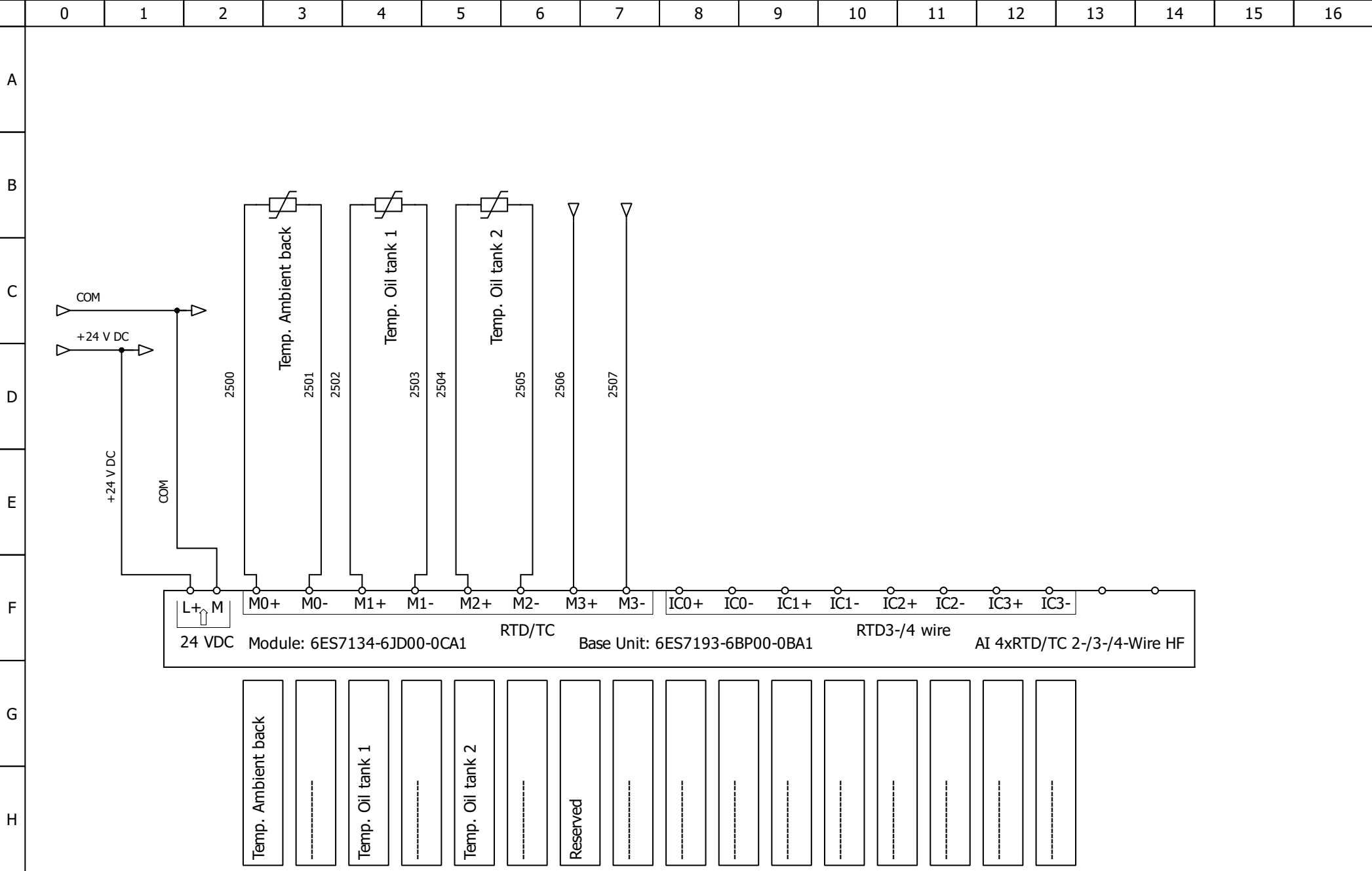
RTD3-/4 wire

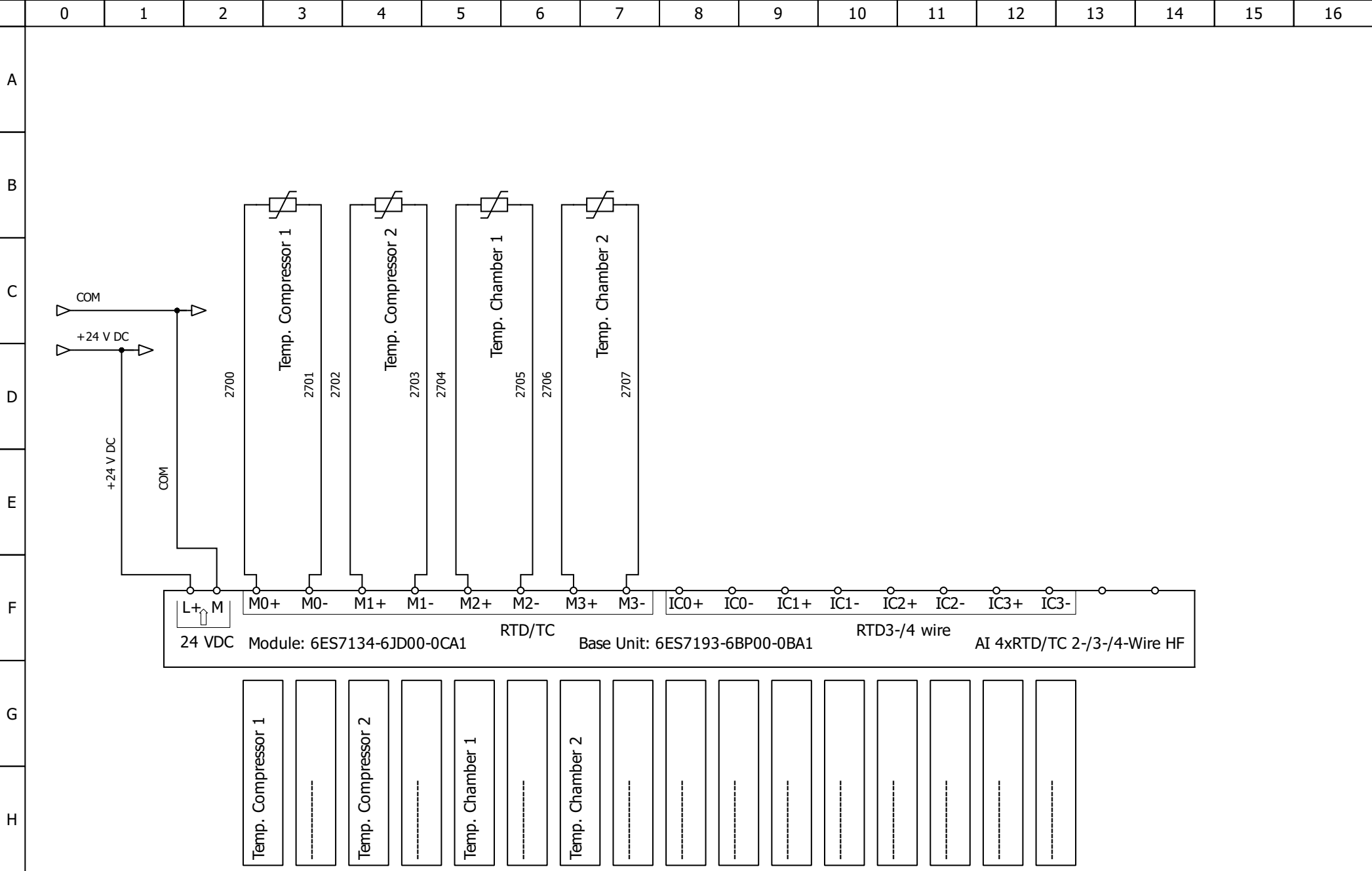
AI 4xRTD/TC 2-/3-/4-Wire HF

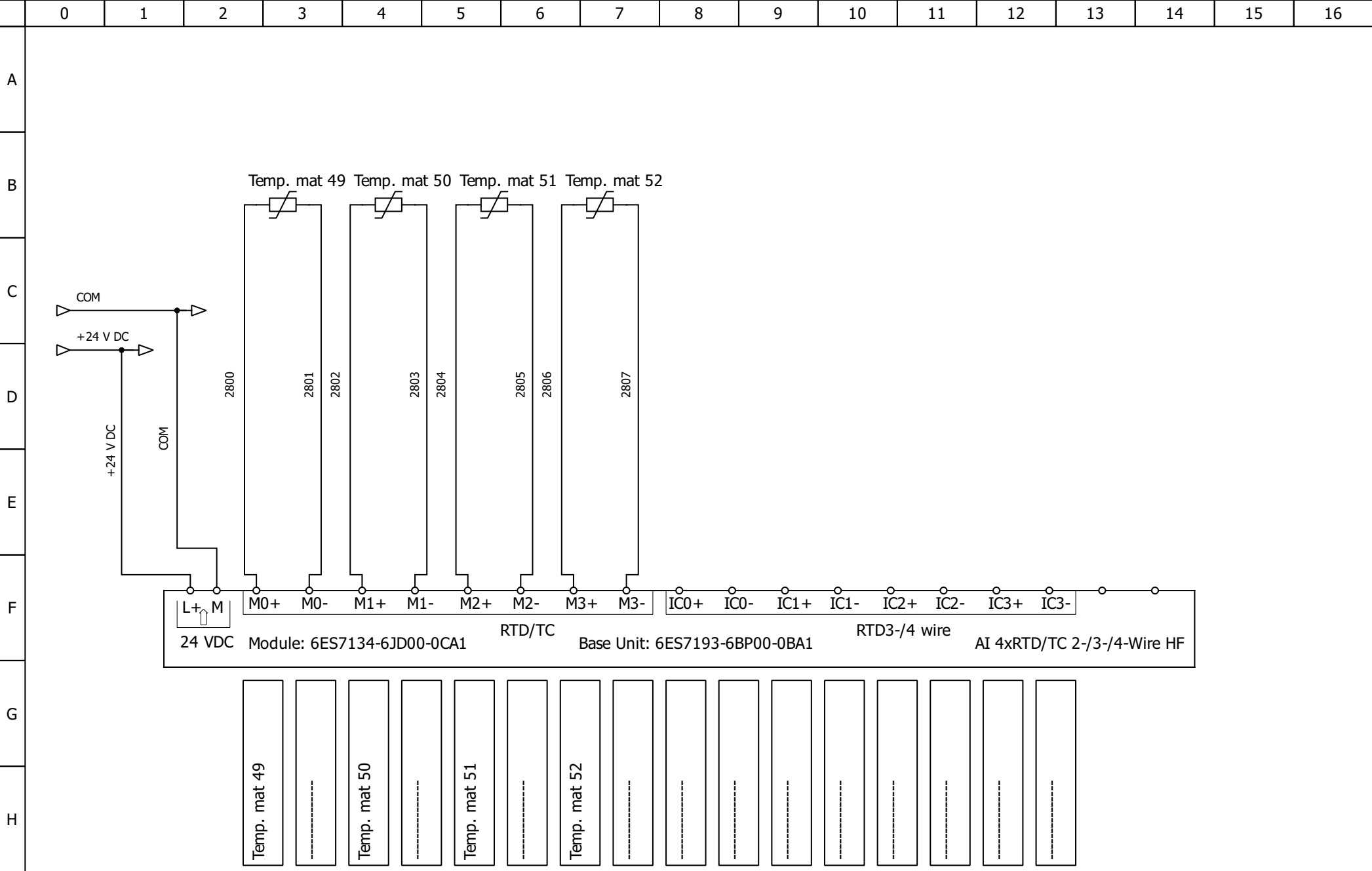


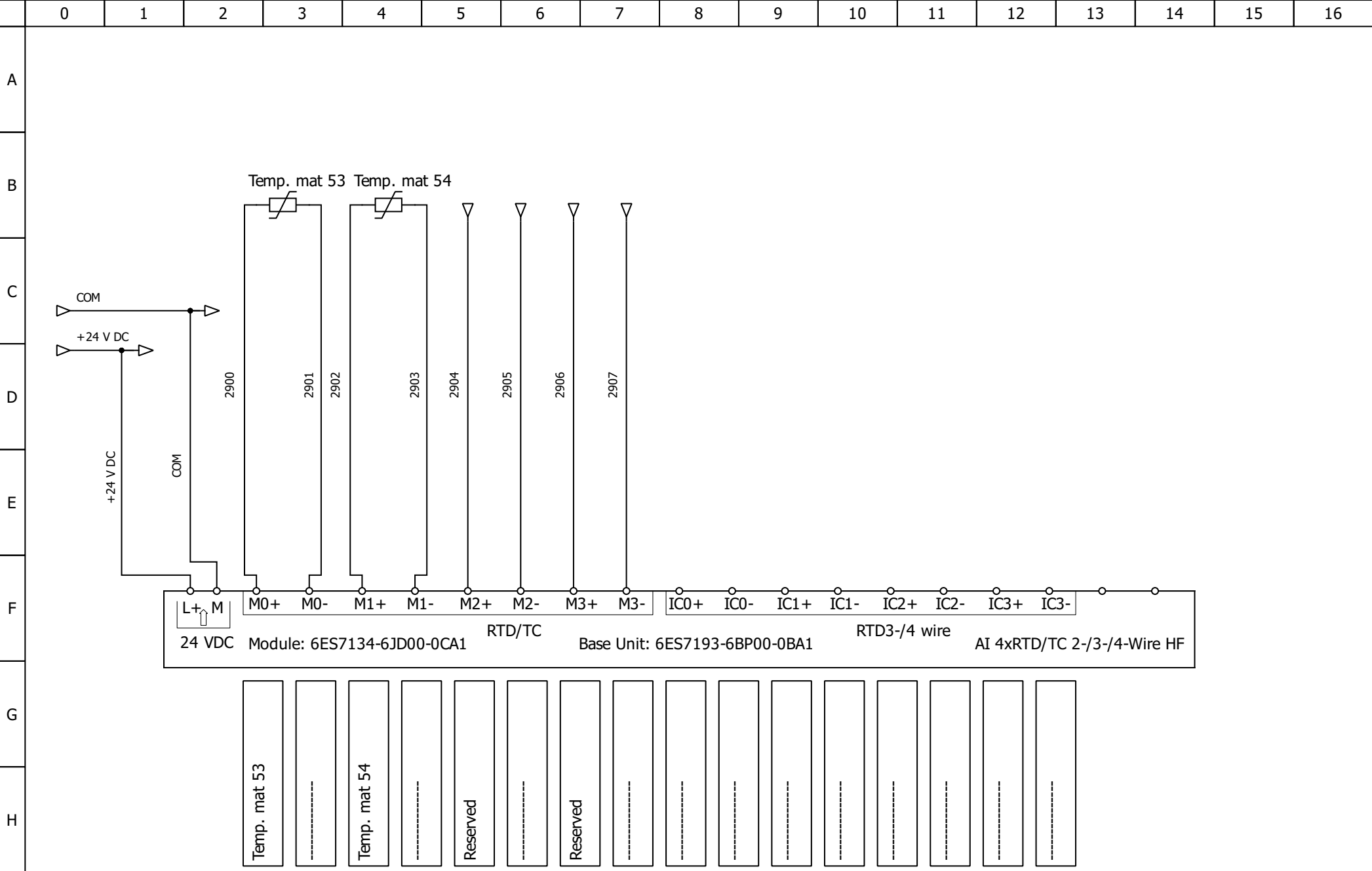


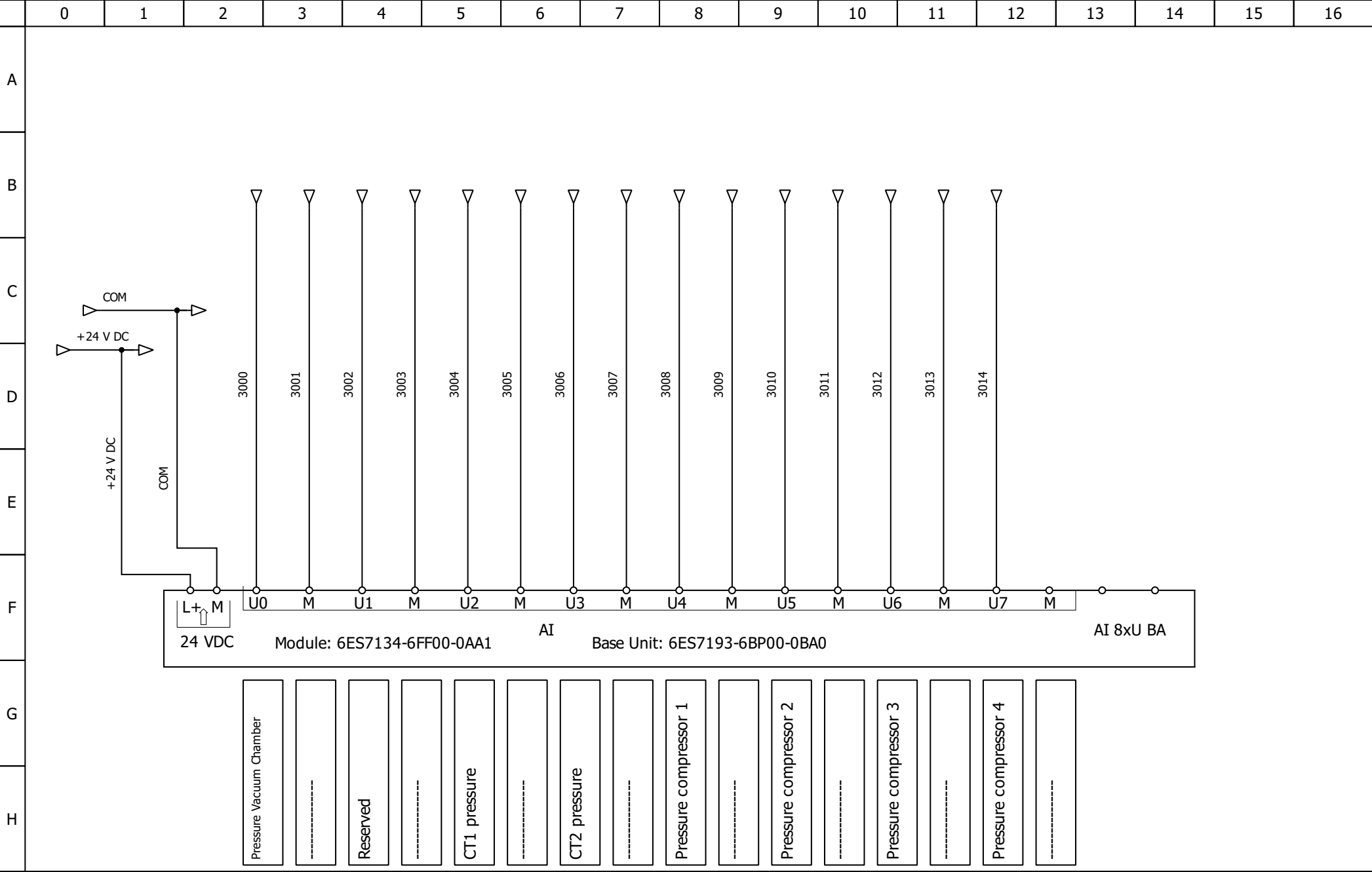


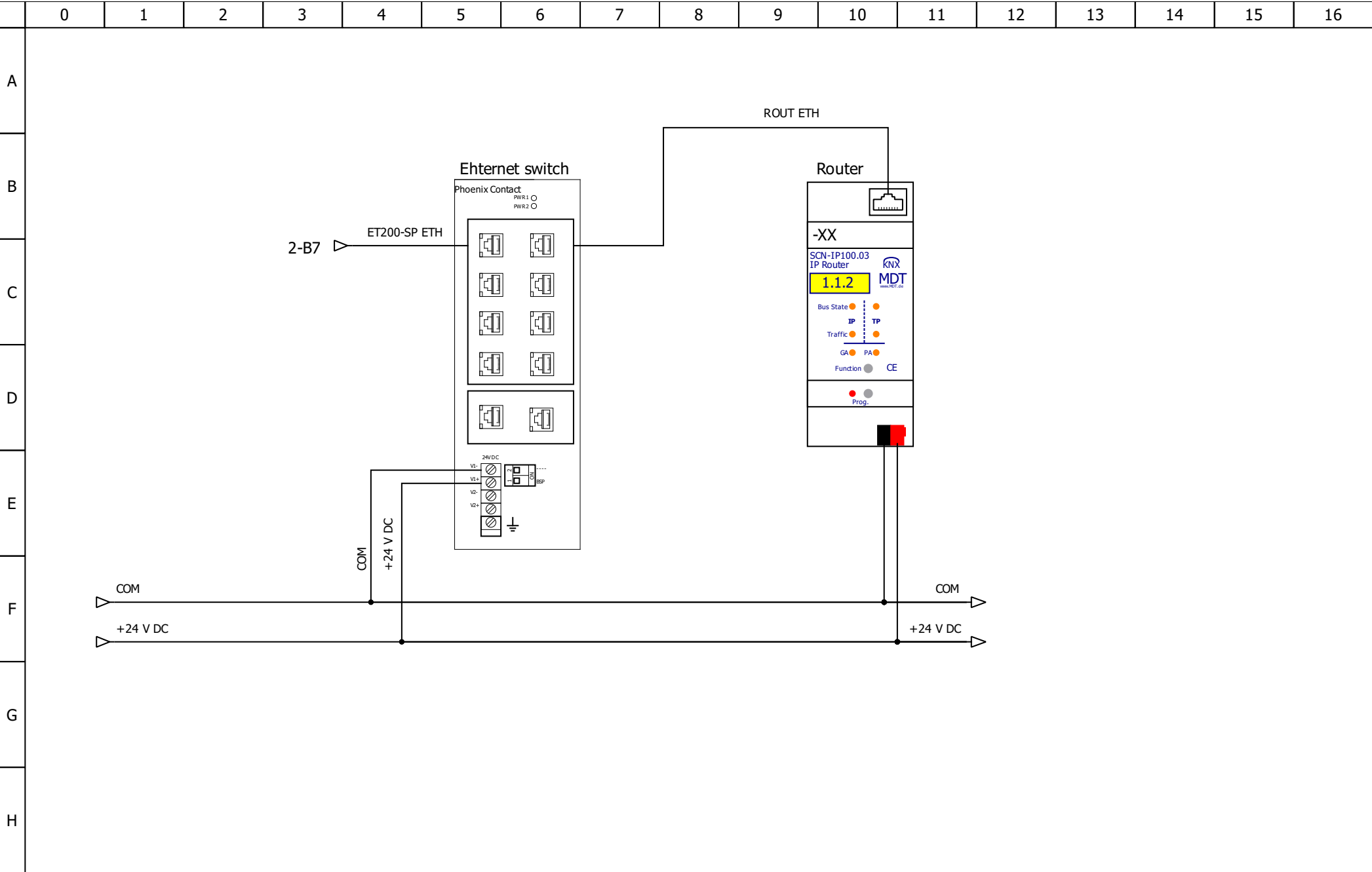


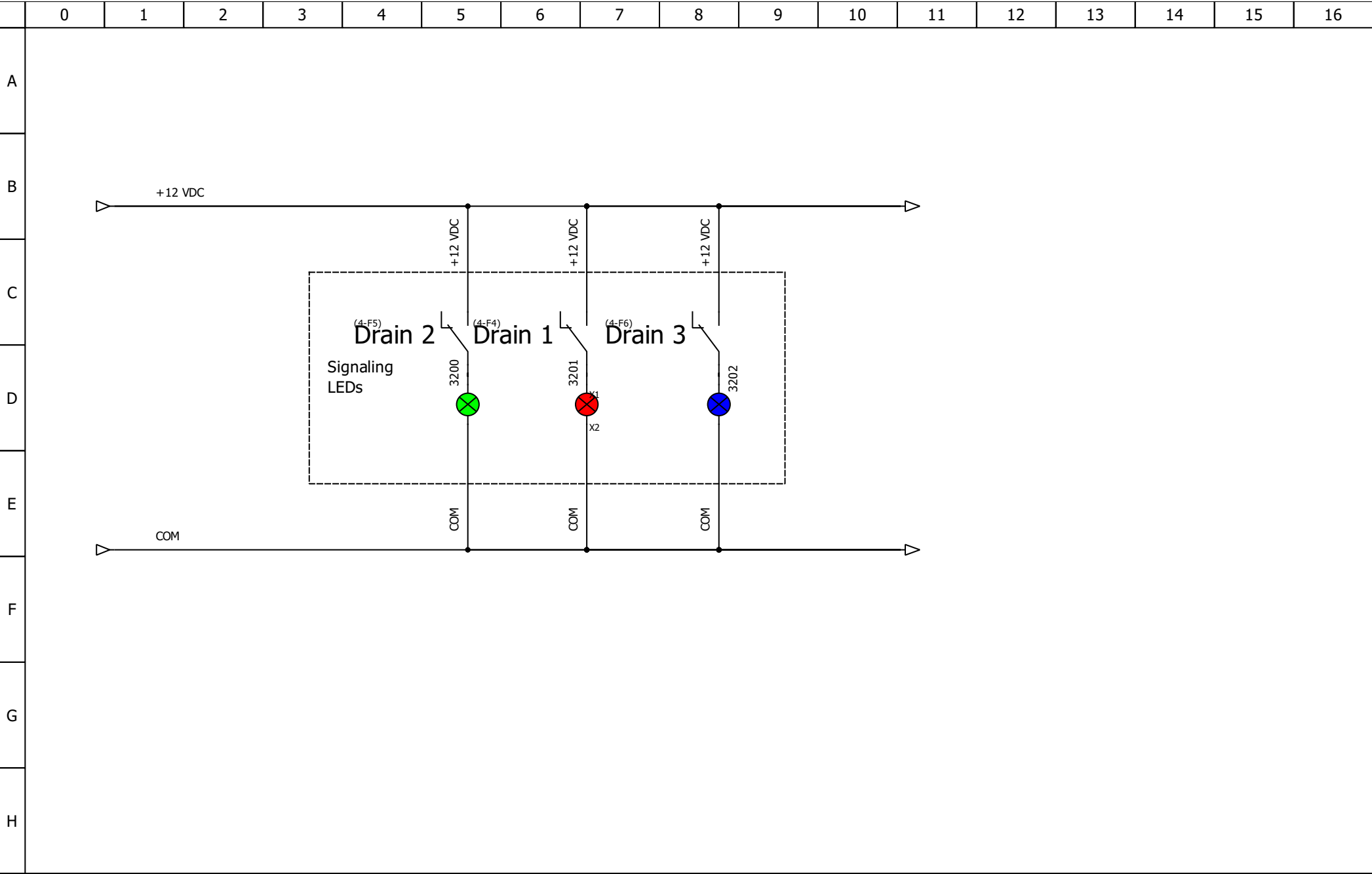


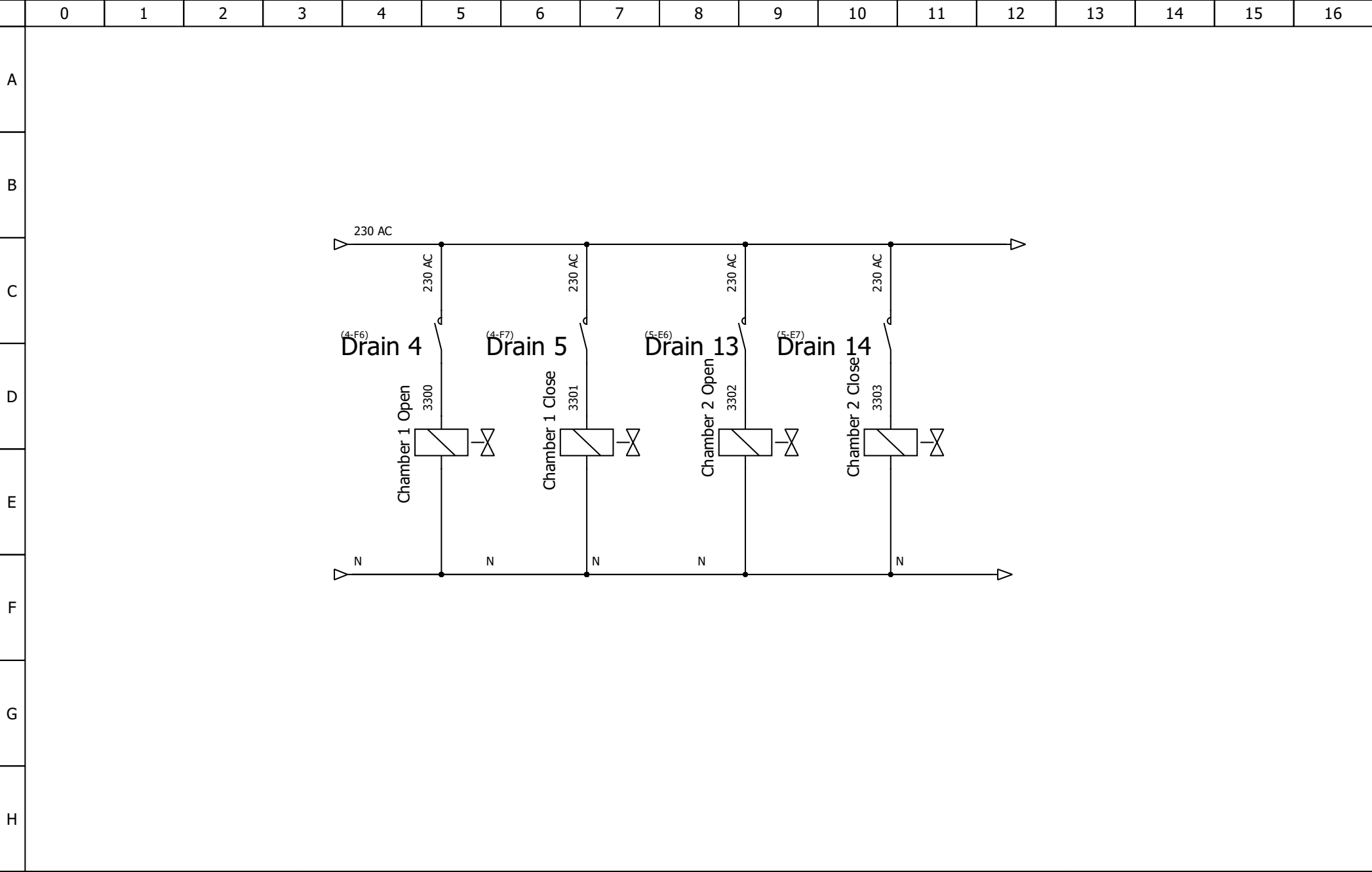


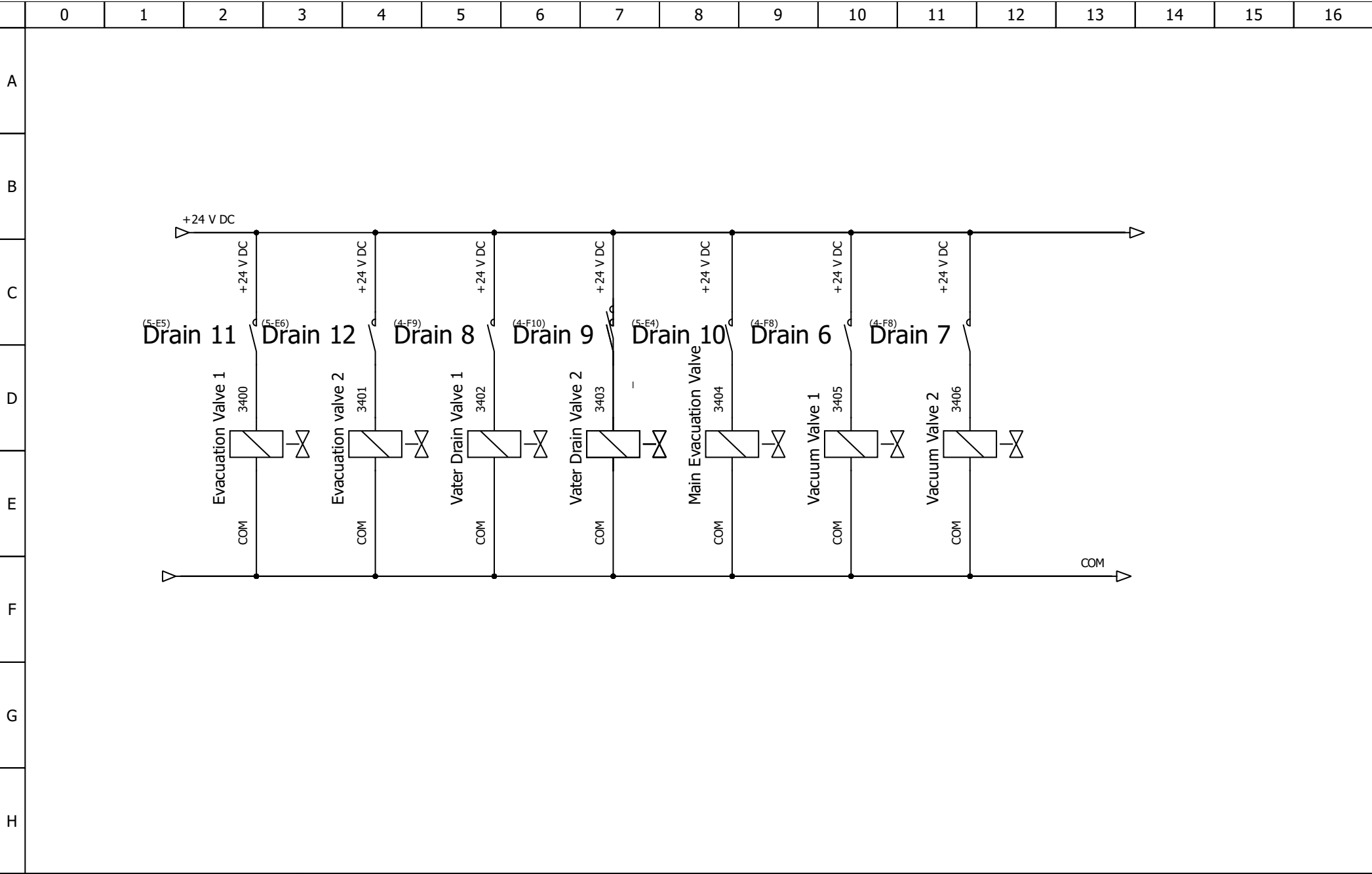


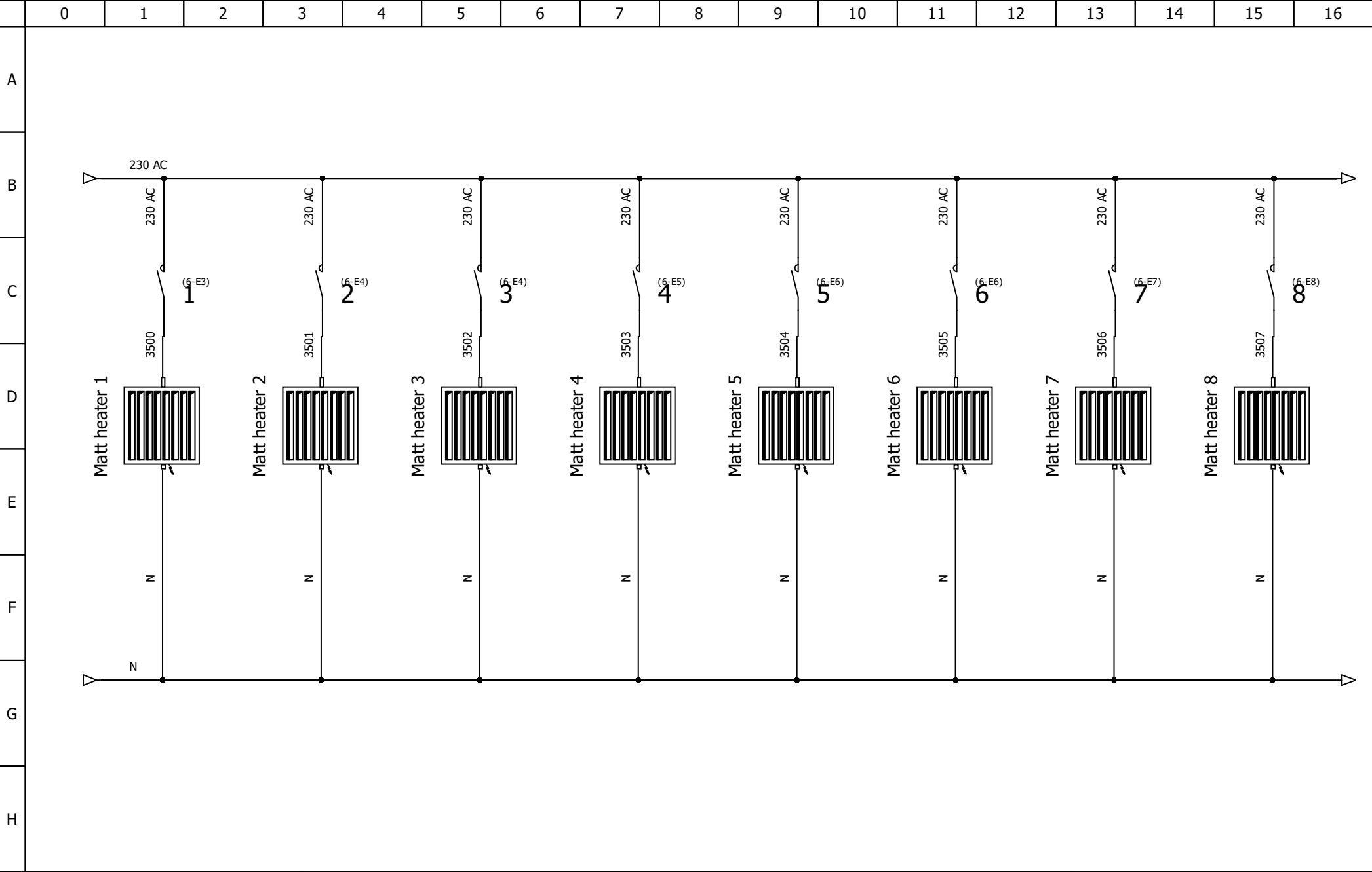


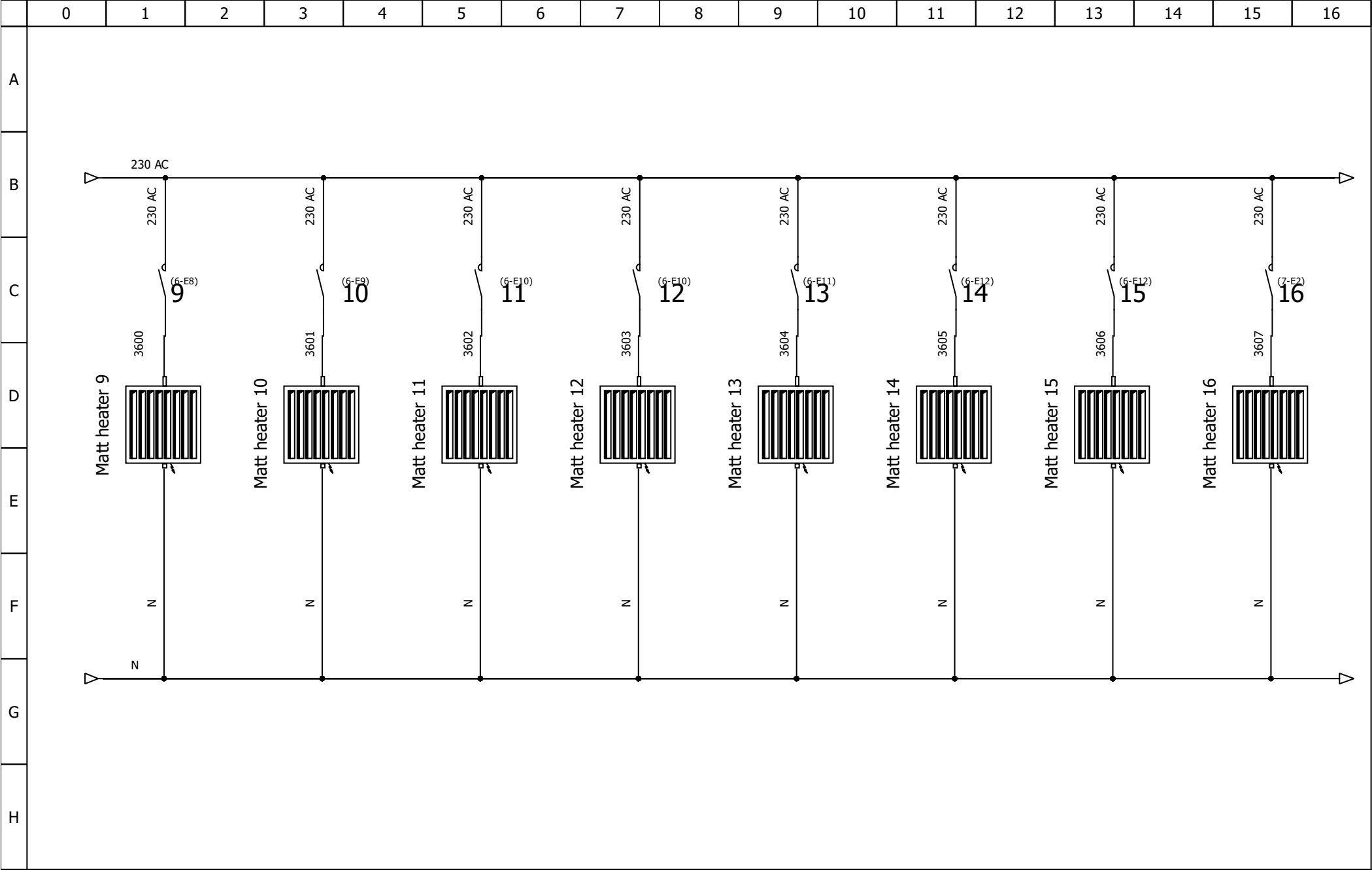


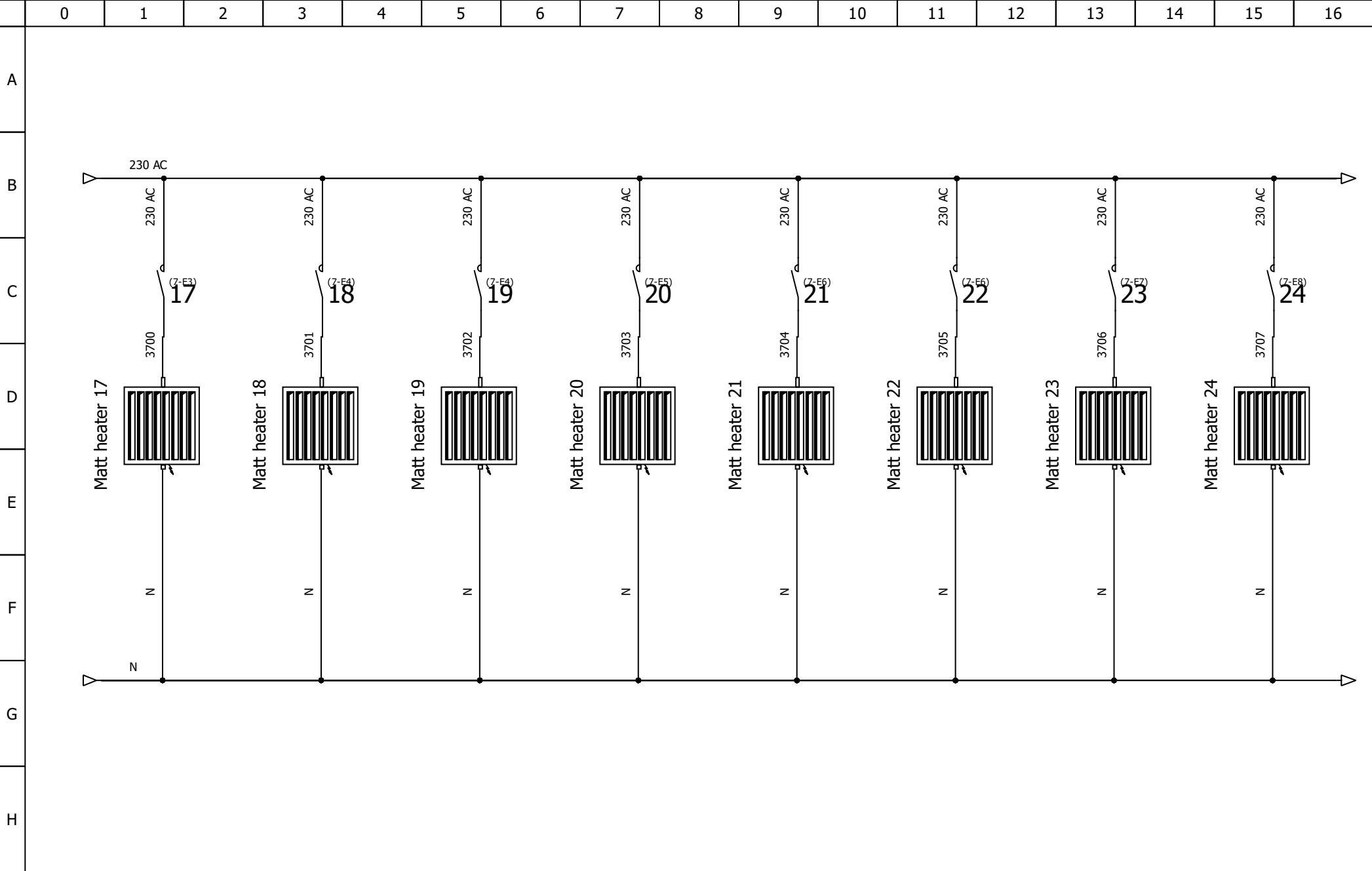


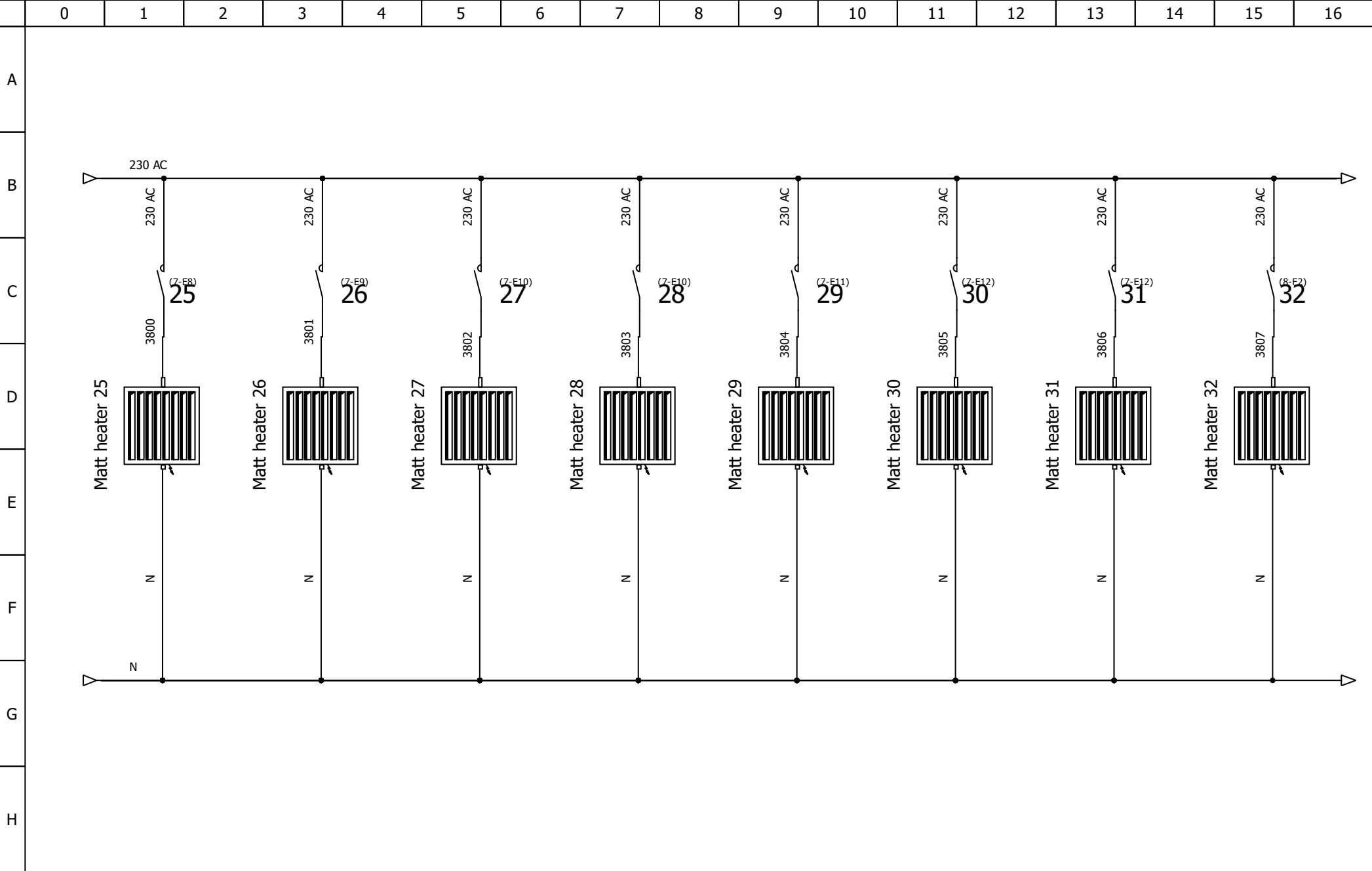


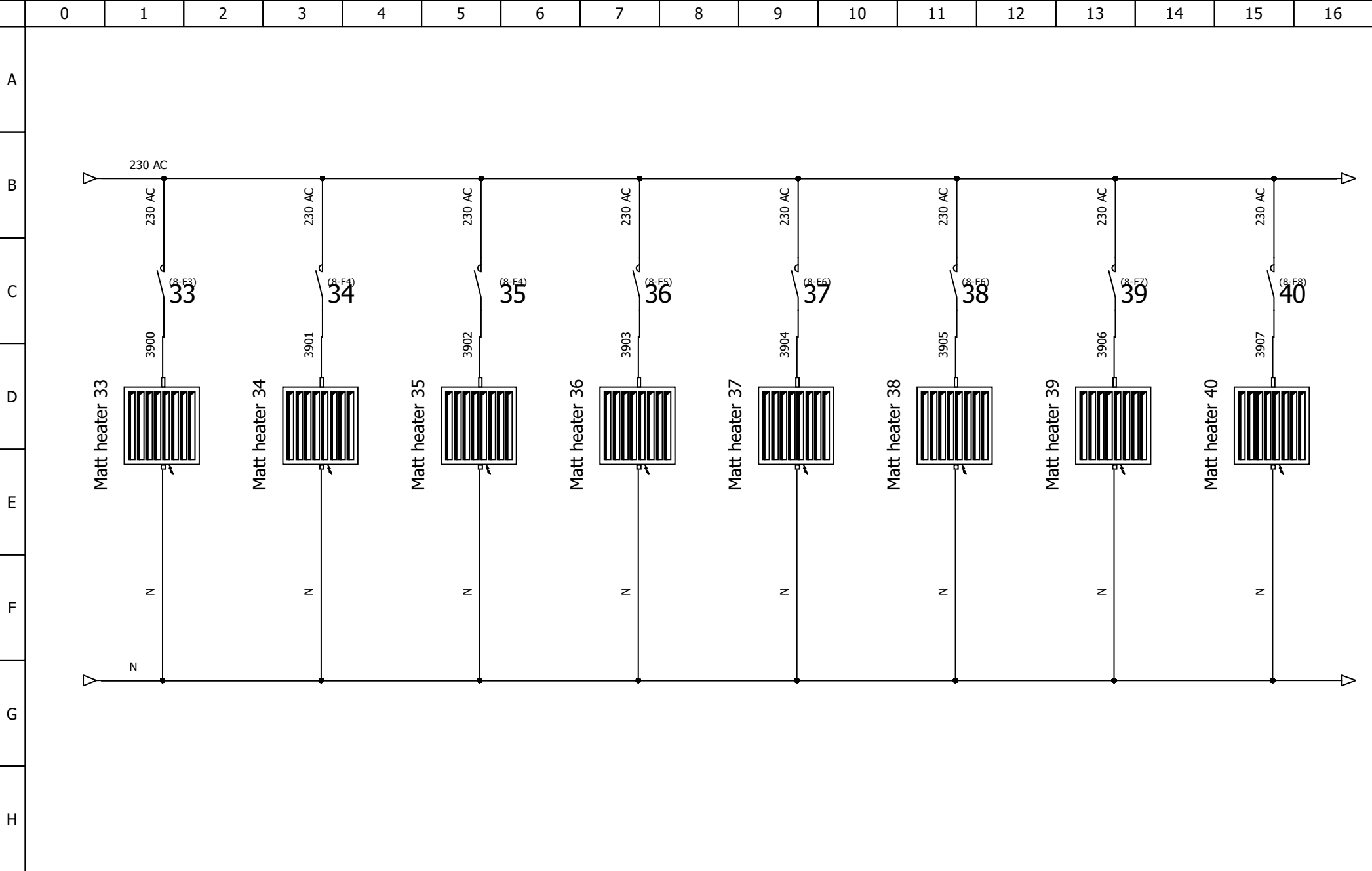


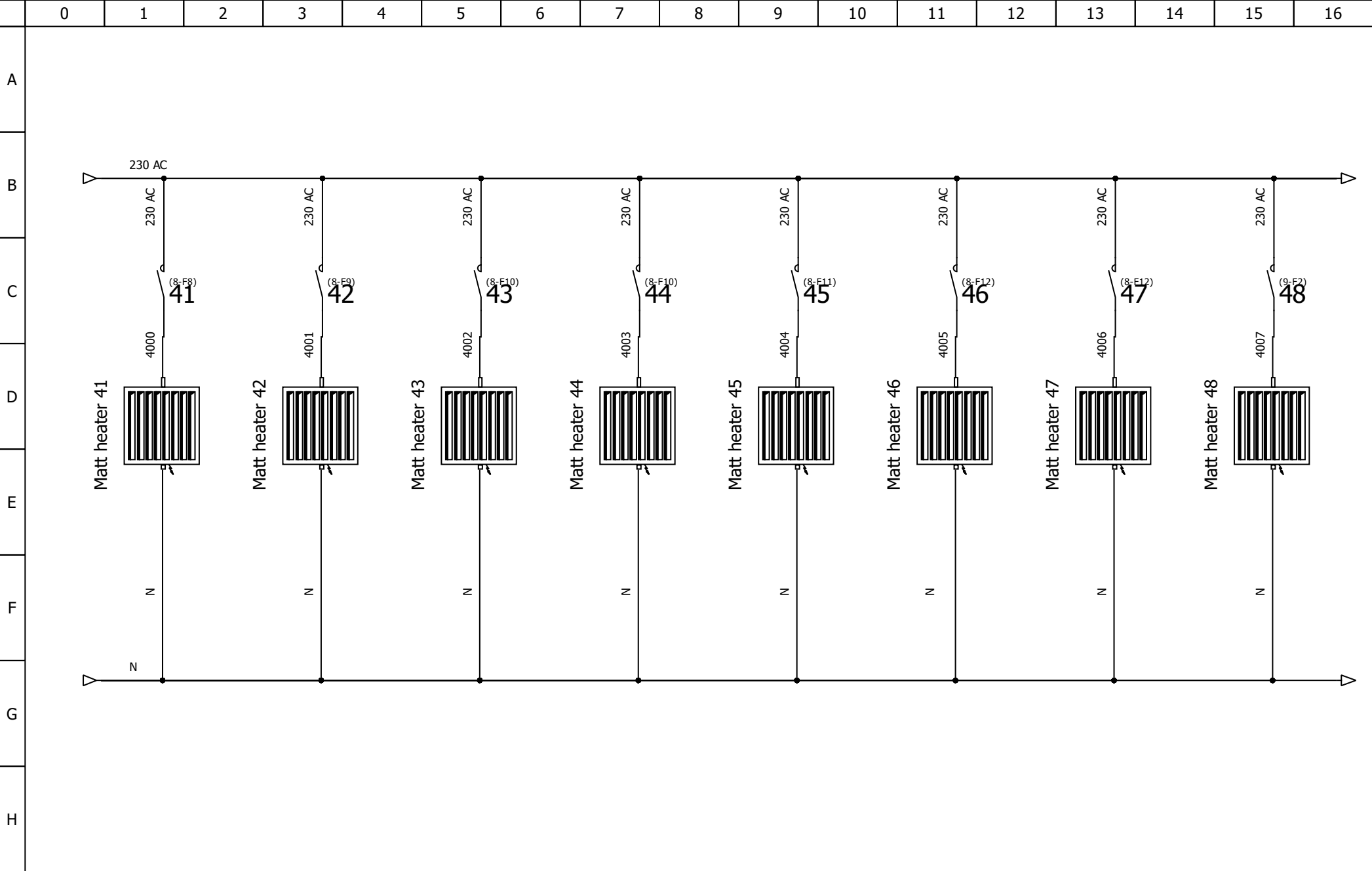


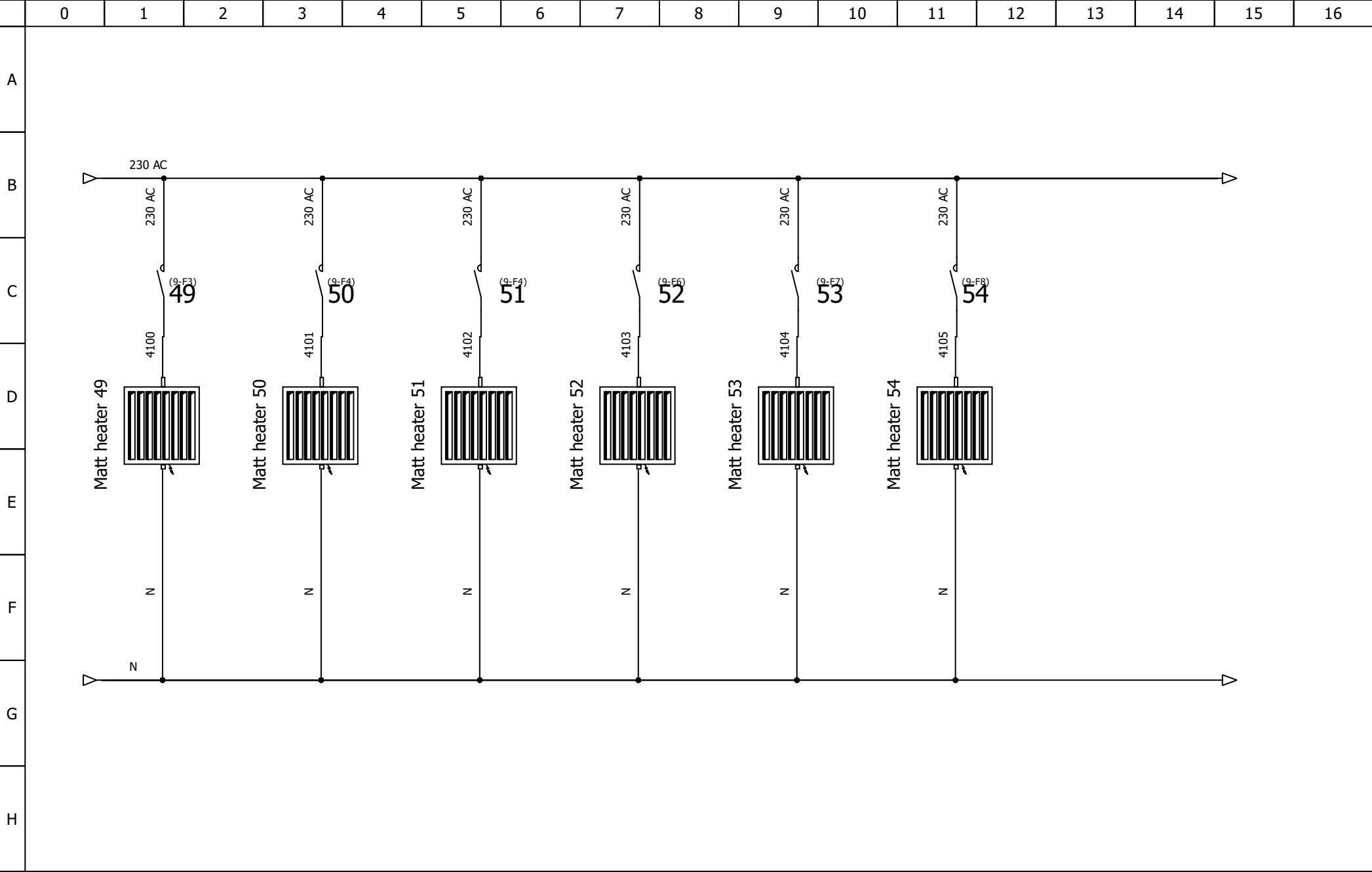


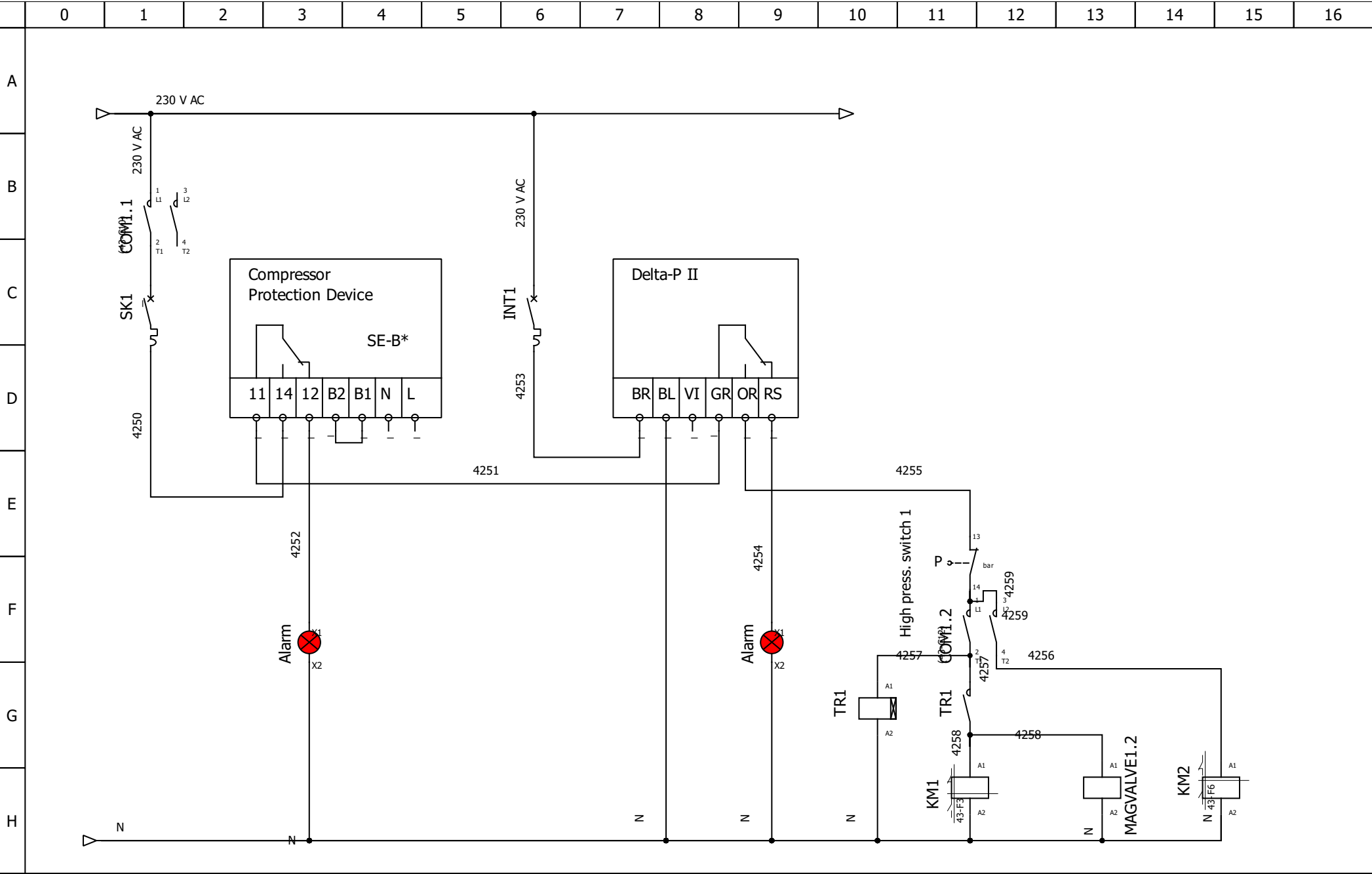


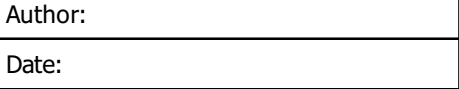


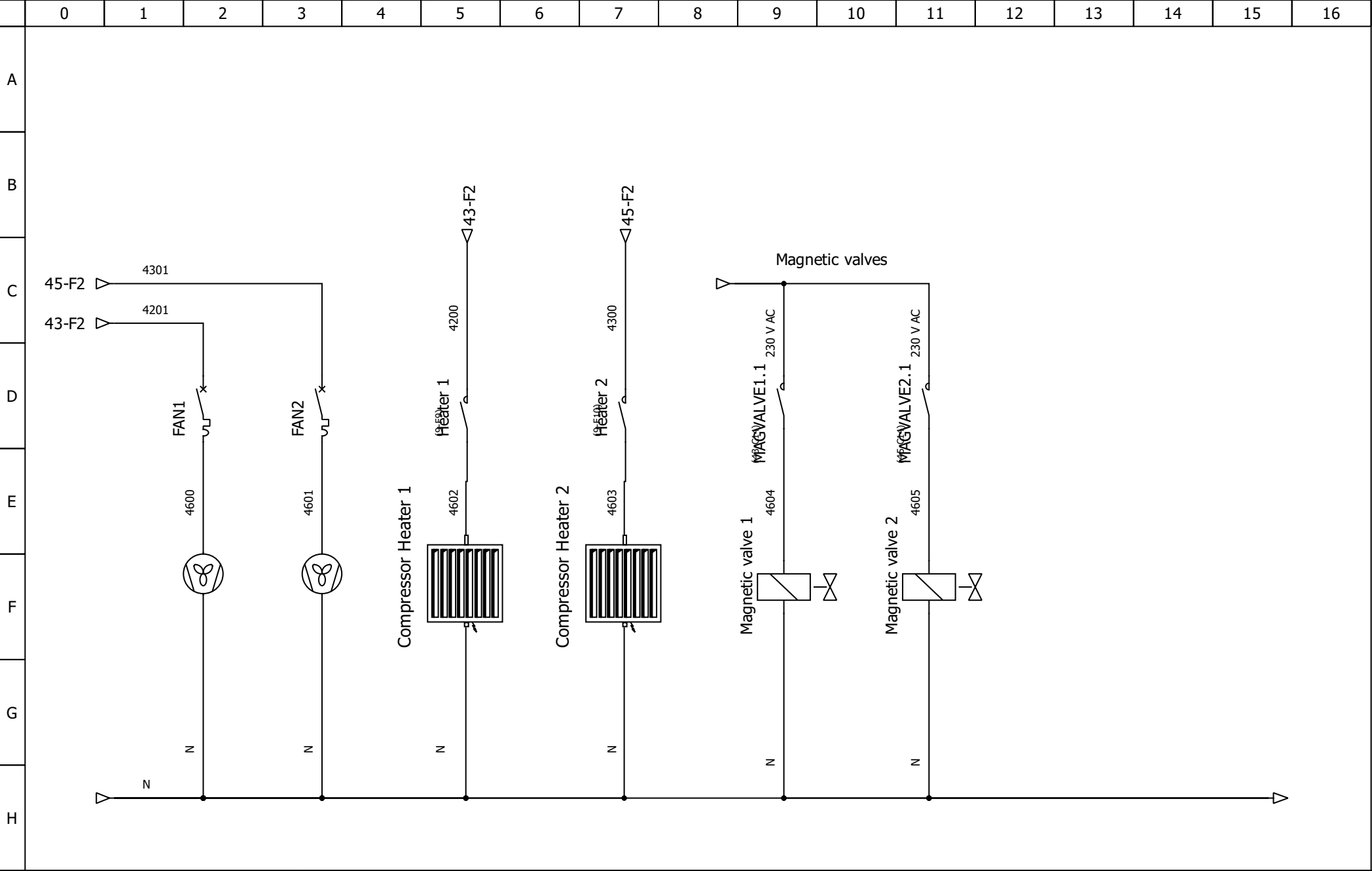


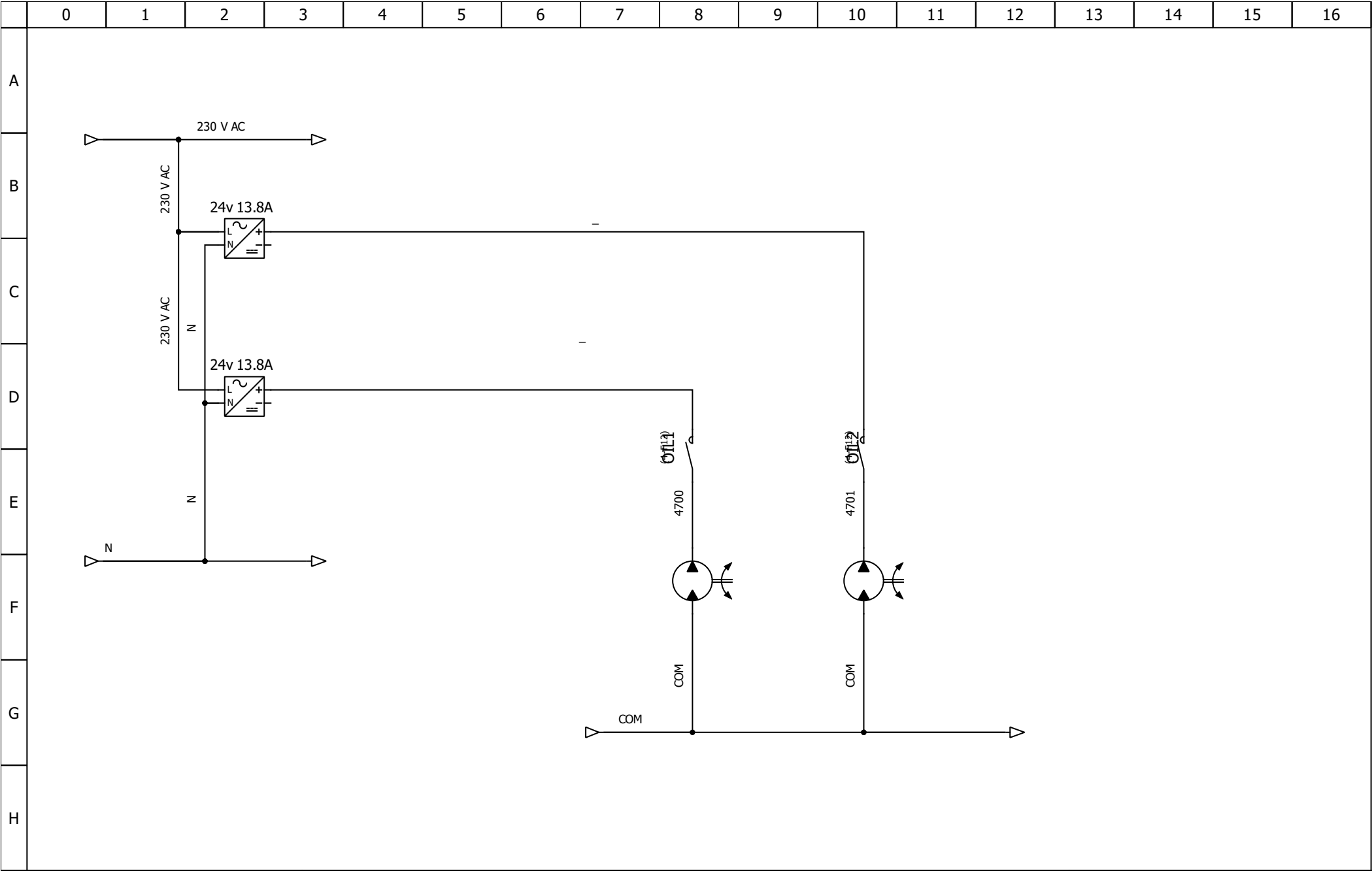


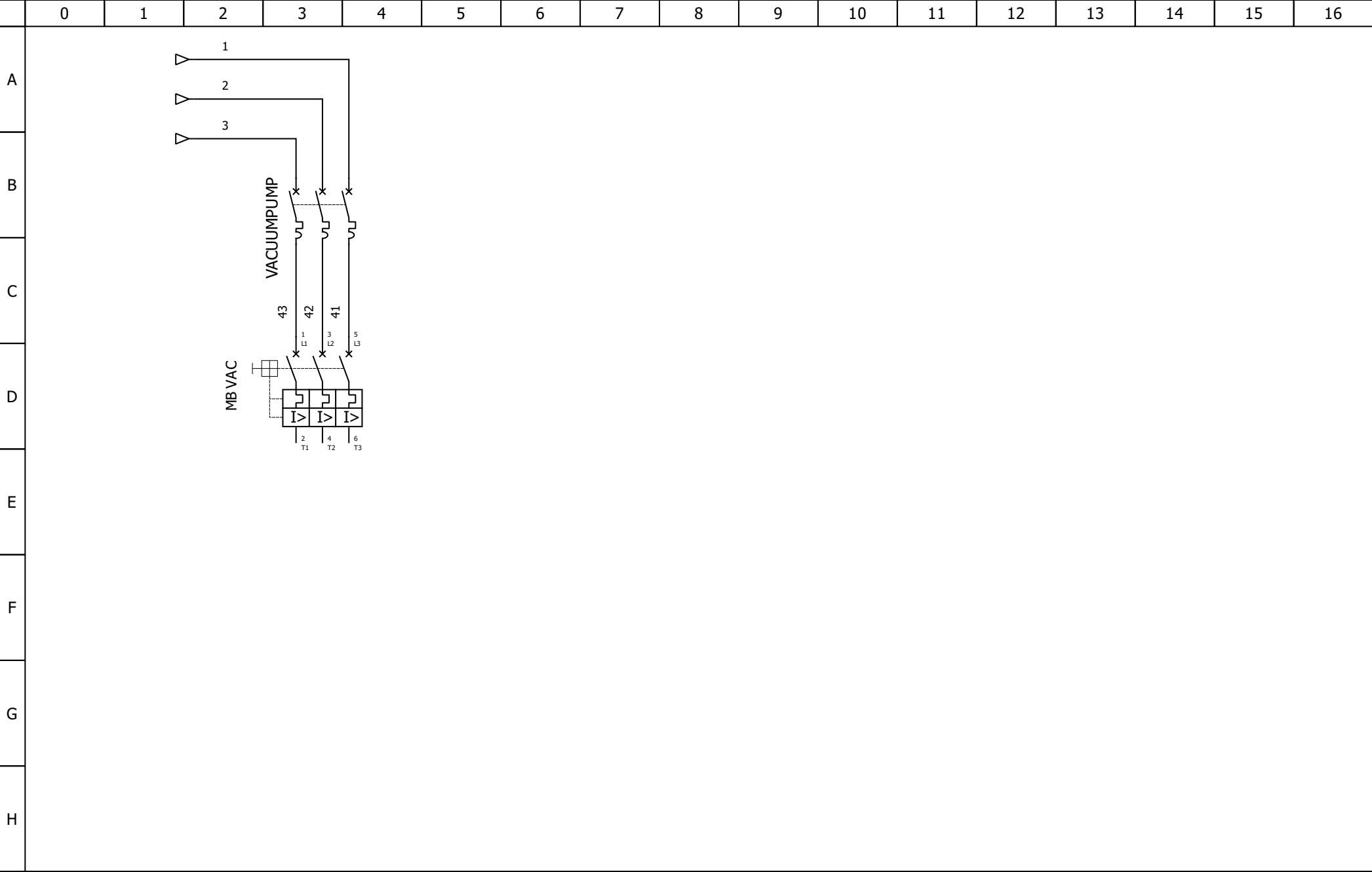












Cleaning, disinfection and MULE

1. Prepare the machine and cleaning area

Finish or stop the cycle using the normal operating procedure. Vent the chamber fully before opening it. Complete defrosting and allow parts to reach a safe handling temperature. Then switch off and isolate the equipment as described in the safety instructions. Prevent unintended restart during cleaning.

Remove the product and trays. Handle remaining product, condensate and cleaning waste according to the site procedure. Use the protective equipment specified for the product and cleaning agents. Keep dirty parts separate from cleaned parts.

2. Remove the drawer unit with the WAVE MULE

Where fitted, use the model-compatible WAVE MULE to support and remove the complete drawer/loading unit. The unit can then be cleaned on the MULE, and the empty chamber becomes accessible. Follow the handling instructions for the supplied machine and MULE; secure the trolley and load against movement or tipping.

Protect the cables and connections at the rear of the unit. Never pull on them. Only disconnect connections designed for operator disconnection, following the model instructions. With permanently wired units, respect the available cable reach and keep the MULE beside the machine; do not move the unit to a remote wash area while it remains attached.

3. Clean the trays, loading unit and chamber

Clean trays after each cycle. Clean the drawer unit, chamber and accessible condensate/drain areas at the intervals in the site cleaning plan, and after spills or product changes as required. Remove residues with suitable non-abrasive tools. Use water and a mild detergent compatible with the actual surfaces, seals and heating mats. Remove detergent residues thoroughly with suitable-quality water.

Keep liquid out of the central/top vacuum connections, pump line, electrical parts, connectors and sensors. Do not flood or immerse the assembled drawer unit, or use pressure washing or steam cleaning unless that method is expressly approved for the supplied configuration. Clean the MULE supports and contact surfaces as part of the procedure.

Do not use caustic or abrasive cleaners on the drawer unit or silicone heating mats. A cleaner suitable for stainless steel is not automatically suitable for aluminium, coatings, acrylic, seals or electrical components.

Material compatibility and return to service

4. Acrylic door: protect against chemical damage

Do not use alcohol-containing cleaners or disinfectants on the acrylic door. Avoid contact with their vapours as well.

Acrylic can develop fine stress cracks or be weakened by incompatible chemicals. Do not assume that a general recommendation for acrylic sheet also applies to this vacuum-loaded door.

For routine door cleaning, use a soft, lint-free cloth moistened with lukewarm water and a mild cleaning agent approved for the door. Do not rub the surface dry or use abrasive pads, scouring powders or unsuitable glass cleaners. Inspect the door and seal for damage. If cracks, crazing or other damage are visible, keep the machine out of service and contact WAVE.

Any alternative door disinfection method requires specific compatibility confirmation for the actual door, including the formulation, concentration, temperature, contact time and repeated exposure. A spot test or a general chemical-resistance table is not sufficient.

5. Disinfection, where the process requires it

Clean first; disinfection does not replace removal of residues. The site procedure must identify the agent, concentration, application method, temperature and contact time, together with any rinsing and drying requirements. Use only conditions compatible with every exposed component. The actual delivered materials govern, including any aluminium, coating, elastomer or acrylic surface.

Earlier references in this manual to diluted ethanol, isopropanol or hydrogen peroxide for chamber disinfection are not a universal recipe or approval for all parts. An applicable procedure must prevent exposure of the acrylic door, including vapour exposure, and protect the pump, electrical parts and seals. Do not use such a procedure unless its compatibility and safe execution have been established.

6. Dry, inspect, reassemble and release

Remove cleaning and disinfectant residues as required by the approved procedure. Allow cleaned parts and protected connections to dry fully. Inspect accessible surfaces, seals, the door, drains and the loading unit. Reinstall the drawer unit and connections according to the model instructions, without trapping cables or damaging the seal.

Record the cleaning and complete the checks required by the site before releasing the machine for the next batch. If residues, damage or an unresolved deviation remain, do not release the machine. Cleaning, disinfection and sterilisation are different processes; this chapter does not establish a sterilisation procedure.

Site cleaning plan and GMP responsibility

7. The operator determines suitability for the intended use

The operator is responsible for deciding whether the delivered machine can be integrated into the intended manufacturing process and quality system. Where GMP applies, the operator must define the user requirements, assess suitability, arrange the necessary equipment qualification and process/cleaning validation, and approve the operating procedures and release criteria before use.

This manual, a CE declaration or individual component certificates do not establish GMP compliance of a production process. The scope of technical information, qualification support and additional documentation provided by WAVE must be agreed for the specific configuration. The operator's responsibilities do not change the manufacturer's obligations for the equipment supplied.

8. Define and document the cleaning procedure

Set the frequency and sequence according to the product, contamination risk and site requirements. Include hard-to-reach areas, product changes, relevant allergens, dirty/clean holding times, and the handling of the MULE and removable parts. Train the personnel who carry out and check the procedure.

For GMP use, manual cleaning requires a justified validation approach and periodic confirmation of effectiveness. Visual cleanliness is a useful check but normally is not sufficient on its own. The responsible quality unit defines appropriate residue limits, sampling locations and methods, microbiological checks where relevant, and the response to deviations.

Cleaning record: minimum entries

Identification	Machine / serial number, procedure and revision, product and batch, reason for cleaning.
Execution	Date and times, operator, cleaned areas, MULE use and removed/reinstalled parts.
Agents and parameters	Agent identity and batch, prepared concentration, temperature, contact time, water quality, rinsing and drying.
Verification	Visual findings and any required samples/results; condition of door, seal, cables and connections.
Release	Deviations and actions, completed reassembly, responsible reviewer, release decision and date/time.

Reference: EU GMP Annex 15, section 10 (Cleaning Validation), including 10.15 for manual cleaning. Apply the requirements relevant to the intended activity and jurisdiction. [Official Annex 15](#).

CERTIFICATE OF COMPLIANCE

Certificate Number UL-CA-2217226-3
Report Reference E123528-20220427
Date 9-Jun-2022

Issued to: PHOENIX CONTACT GmbH & Co. KG
Flachsmarktstrasse 8 Blomberg 32825
Germany

This is to certify that
representative samples of

NMTR7 - Power Circuit and Motor-mounted Apparatus
Certified for Canada
See Addendum Page for Product Designation(s).

Have been investigated by UL in accordance with the
Standard(s) indicated on this Certificate.

Standard(s) for Safety: CSA C22.2 NO. 61010-1, 3rd Ed., Issue Date: 2012-05-11,
Revision Date: 2018-11-01, CSA C22.2 NO. 61010-2-
201:18, 2nd Ed., Issue Date: 2018-02-01

Additional Information: See the UL Online Certifications Directory at
<https://iq.ulprospector.com> for additional information

This Certificate of Compliance does not provide authorization to apply the UL Mark. Only the UL Follow-Up Services Procedure provides authorization to apply the UL Mark.

Only those products bearing the UL Mark should be considered as being UL Certified and covered under UL's Follow-Up Services.

Look for the UL Certification Mark on the product.

B. Mahlen

Bruce Mahlenholz, Director North American Certification Program

UL LLC

Any information and documentation involving UL Mark services are provided on behalf of UL LLC (UL) or any authorized licensee of UL. For questions, please contact a local UL Customer Service Representative at <http://ul.com/aboutul/locations/>



CERTIFICATE OF COMPLIANCE

Certificate Number UL-CA-2217226-3
Report Reference E123528-20220427
Date 9-Jun-2022

This is to certify that representative samples of the product as specified on this certificate were tested according to the current UL requirements

Model	Category Description
UNO2-PS/1AC/24DC/960W, may be followed by a suffix of one or more alphanumeric or special characters including " - / , . _ " or semicolon or blank, for internal references only, not safety relevant.	Switching power supplies



Bruce Mahrenholz, Director North American Certification Program

UL LLC



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CERTIFICATE OF COMPLIANCE

Certificate Number UL-US-2217786-2
Report Reference E123528-20220427
Date 9-Jun-2022

Issued to: PHOENIX CONTACT GmbH & Co. KG
Flachsmarktstrasse 8 Blomberg 32825
Germany

This is to certify that
representative samples of NMTR - Power Circuit and Motor-mounted Apparatus
See Addendum Page for Product Designation(s).

Have been investigated by UL in accordance with the
Standard(s) indicated on this Certificate.

Standard(s) for Safety: UL 61010-1, 3rd Ed., Issue Date: 2012-05-11, Revision
Date: 2019-07-19, UL 61010-2-201, 2nd Ed., Issue Date:
2018-05-14

Additional Information: See the UL Online Certifications Directory at
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CERTIFICATE NUMBER 19- HG1879891-PDA

EFFECTIVE DATE 14-Aug-2019

EXPIRATION DATE 13-Aug-2024

ABS TECHNICAL OFFICE

Hamburg Engineering Department

CERTIFICATE OF

Product Design Assessment

This is to certify that a representative of this Bureau did, at the request of

ABB STOTZ KONTAKT GMBH

located at

**EPPELHEIMER STR. 82,
D-69123 HEIDELBERG, GERMANY**

assess design plans and data for the below listed product. This assessment is a representation by the Bureau as to the degree of compliance the design exhibits with applicable sections of the Rules. This assessment does not waive unit certification or classification procedures required by ABS Rules for products to be installed in ABS classed vessels or facilities. This certificate, by itself, does not reflect that the product is Type Approved. The scope and limitations of this assessment are detailed on the pages attached to this certificate.

Product Contactor, Electrical

Model ESB16-xxN, ESB20-xxN, ESB25-xxN, ESB40-xxN, ESB63-xxN, ESB100-xxN, EH04-xxN

This Product Design Assessment (PDA) Certificate remains valid until 13-Aug-2024 or until the Rules and/or Standards used in the assessment are revised or until there is a design modification warranting design reassessment (whichever occurs first).

Acceptance of product is limited to the "Intended Service" details prescribed in the certificate and as per applicable Rules and Standards.

This Certificate is valid for installation of the listed product on ABS units which exist or are under contract for construction on or previous to the effective date of the ABS Rules and standards applied at the time of PDA issuance. Use of the Product for non-ABS units is subject to agreement between the manufacturer and intended client.

American Bureau of Shipping

Efstratios Maliatsos
Engineer/Consultant

NOTE: This certificate evidences compliance with one or more of the Rules, Guides, standards or other criteria of ABS or a statutory, industrial or manufacturer's standards. It is issued solely for the use of ABS, its committees, its clients or other authorized entities. Any significant changes to the aforementioned product without approval from ABS will result in this certificate becoming null and void. This certificate is governed by ABS Rules 1-1-A3/5.9 Terms and Conditions of the Request for Product Type Approval and Agreement (2010)



CERTIFICATE NUMBER 19- HG1879891-PDA-DUP

EFFECTIVE DATE 14-August-2019

EXPIRATION DATE 14-August-2024

ABS TECHNICAL OFFICE

Hamburg Engineering Department

CERTIFICATE OF

Product Design Assessment

This is to certify that a representative of this Bureau did, at the request of

ABB BULGARIA EOOD- RAKOVSKI BRANCH

located at

**14, INDUSTRIALEN PUT 1, STRYAMA
BULGARIA 4142**

assess design plans and data for the below listed product. This assessment is a representation by the Bureau as to the degree of compliance the design exhibits with applicable sections of the Rules. This assessment does not waive unit certification or classification procedures required by ABS Rules for products to be installed in ABS classed vessels or facilities. This certificate, by itself, does not reflect that the product is Type Approved. The scope and limitations of this assessment are detailed on the pages attached to this certificate.

Product Contactor, Electrical

Model ESB16-xxN, ESB20-xxN, ESB25-xxN, ESB40-xxN, ESB63-xxN, ESB100-xxN, EH04-xxN

This Product Design Assessment (PDA) Certificate remains valid until 14-August-2024 or until the Rules and/or Standards used in the assessment are revised or until there is a design modification warranting design reassessment (whichever occurs first).

Acceptance of product is limited to the "Intended Service" details prescribed in the certificate and as per applicable Rules and Standards.

This Certificate is valid for installation of the listed product on ABS units which exist or are under contract for construction on or previous to the effective date of the ABS Rules and standards applied at the time of PDA issuance. Use of the Product for non-ABS units is subject to agreement between the manufacturer and intended client.

American Bureau of Shipping

Efstratios Maliatsos
Engineer/Consultant

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CERTIFICATE OF COMPLIANCE

Certificate Number E199827
Report Reference E199827-2022-05-26
Date 2022-June-20

Issued to: PHOENIX CONTACT GmbH & Co. KG
Flachsmarktstrasse 8
Blomberg 32825 DE

This is to certify that
representative samples of

PROCESS CONTROL EQUIPMENT FOR USE IN
HAZARDOUS LOCATIONS

See Addendum Page for Product Designation(s).

Have been evaluated by UL in accordance with the
Standard(s) indicated on this Certificate.

Standard(s) for Safety: See Addendum Page for Standard(s) for Safety

Additional Information: See the UL Online Certifications Directory at
<https://iq.ulprospector.com> for additional information

This Certificate of Compliance indicates that representative samples of the product described in the certification report have met the requirements for UL certification. It does not provide authorization to apply the UL Mark. Only the Authorization Page that references the Follow-Up Services Procedure for ongoing surveillance provides authorization to apply the UL Mark.

Only those products bearing the UL Mark should be considered as being UL Certified and covered under UL's Follow-Up Services.

Look for the UL Certification Mark on the product.



Bruce Mahrenholz, Director North American Certification Program

UL LLC

Any information and documentation involving UL Mark services are provided on behalf of UL LLC (UL) or any authorized licensee of UL. For questions, please contact a local UL Customer Service Representative at <http://ul.com/aboutul/locations/>



CERTIFICATE OF COMPLIANCE

Certificate Number E199827
Report Reference E199827-2022-05-26
Date 2022-June-20

This is to certify that representative samples of the product as specified on this certificate were tested according to the current UL requirements

USL, CNL – Power Supply for use in Class I, Division 2, Groups A, B, C, D Hazardous Locations.

Model: UNO2-PS/1AC/24DC/960W

All model/catalogue number(s) may be followed by a suffix of one or more alphanumeric or special characters including " - / , . _ " or semicolon or blank, for internal references only, not safety relevant.

Standard(s) for Safety

UL61010-1 Electrical Equipment For Measurement, Control, and Laboratory Use; Part 1: General Requirements

UL61010-2-201 Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part 2-201: Particular Requirements for Control Equipment

CAN/CSA-C22.2 No. 61010-1:12 Electrical Equipment For Measurement, Control, and Laboratory Use; Part 1: General Requirements

CAN/CSA-C22.2 No. 61010-2-201:18 Safety requirements for electrical equipment for measurement, control, and laboratory use — Part 2-201: Particular requirements for control equipment



Bruce Mahrenholz, Director North American Certification Program

UL LLC

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Certificate of Compliance

Certificate Number:

UL-US-L191658-112-
10306991-5

Report Reference:

E191658-19960301

Issue Date:

2024-08-01

Issued to:

**ABB Stotz-Kontakt GmbH
Eppelheimer Str 82 Heidelberg 69123
Germany**

This certificate confirms that representative samples of:

NLDX - Motor Controllers, Magnetic

See Addendum Page for Product Designation(s).

Have been evaluated by UL in accordance with the Standard(s) indicated on this Certificate.

**UL 60947-4-1, 3rd Ed., Issue Date: 2014-04-04, Revision Date:
2017-10-17, UL 60947-1, 5th Ed., Issue Date: 2013-07-31,
Revision Date: 2019-05-06**

Additional Information:

See UL Product iQ® at <https://iq.ulprospector.com> for additional information.

This Certificate of Compliance indicates that representative samples of the product described in the certification report have met the requirements for UL certification. It does not provide authorization to apply the UL Mark. Only the Authorization Page that references the Follow-Up Services Procedure for ongoing surveillance provides authorization to apply the UL Mark.

Only those products bearing the UL Mark should be considered as being UL Certified and covered under UL's Follow-Up Services.

Look for the UL Certification Mark on the product.



David Piecuch
UL Mark Certification Program Manager



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CERTIFICATE OF COMPLIANCE

Certificate number UL-US-L191658-112-10306991-5
Report reference E191658-19960301
Date 2024-08-01

This is to certify that representative samples of the product as specified on this certificate were tested according to the current UL requirements.

Model	Product Description
EH04-11, may be followed by N	Accessory Open type
EH04-20, may be followed by N	Accessory Open type
ESB100, followed by -40 or -20, followed by N	Open type, Motor controllers
ESB16, followed by -11, -20 or -02, followed by N.	Open type, Motor controllers
ESB20, followed by -11, -20 or -02, followed by N	Open type, Motor controllers
ESB24, followed by -0, 1, 2, 3 or 4, followed by 0, 1, 2, 3 or 4.	Open type, Motor controllers
ESB25, followed by -0, -1, -2, -3, or -4, followed by 0, 1, 2, 3, or 4 followed by N	Open type, Motor controllers
ESB40, followed by -0, 1, 2, 3 or 4, followed by 0, 1 or 2, may be followed by N, may be followed by -DC-B or E.	Open type, Motor controllers
ESB63, followed by -0, 1, 2, 3 or 4, followed by 0, 1 or 2, may be followed by N, may be followed by -DC-B or E.	Open type, Motor controllers



David Piecuch
UL Mark Certification Program Manager

Any information and documentation involving UL Mark services are provided on behalf of UL LLC (UL) or any authorized licensee of UL. For questions, please contact UL Solutions Customer Service at <https://www.ul.com/contact-us>.



Certificate of Compliance

Certificate Number:

UL-CA-L191658-412-
10306991-5

Report Reference:

E191658-19960301

Issue Date:

2024-08-01

Issued to:

**ABB Stotz-Kontakt GmbH
Eppelheimer Str 82 Heidelberg 69123
Germany**

This certificate confirms that representative samples of:

NLDX7 - Motor Controllers, Magnetic Certified for Canada

See Addendum Page for Product Designation(s).

Have been evaluated by UL in accordance with the Standard(s) indicated on this Certificate.

**CSA C22.2 NO. 60947-4-1, 2nd Ed., Issue Date: 2014-04-04,
Revised 2018-05, CSA C22.2 No. 60947-1, 2nd Ed., Issue Date:
2013-07-01**

Additional Information:

See UL Product iQ® at <https://iq.ulprospector.com> for additional information.

This Certificate of Compliance indicates that representative samples of the product described in the certification report have met the requirements for UL certification. It does not provide authorization to apply the UL Mark. Only the Authorization Page that references the Follow-Up Services Procedure for ongoing surveillance provides authorization to apply the UL Mark.

Only those products bearing the UL Mark should be considered as being UL Certified and covered under UL's Follow-Up Services.

Look for the UL Certification Mark on the product.



David Piecuch
UL Mark Certification Program Manager



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CERTIFICATE OF COMPLIANCE

Certificate number UL-CA-L191658-412-10306991-5
Report reference E191658-19960301
Date 2024-08-01

This is to certify that representative samples of the product as specified on this certificate were tested according to the current UL requirements.

Model	Product Description
EH04-11, may be followed by N	Accessory Open type
EH04-20, may be followed by N	Accessory Open type
ESB100, followed by -40 or -20, followed by N	Open type, Motor controllers
ESB16, followed by -11, -20 or -02, followed by N.	Open type, Motor controllers
ESB20, followed by -11, -20 or -02, followed by N	Open type, Motor controllers
ESB24, followed by -0, 1, 2, 3 or 4, followed by 0, 1, 2, 3 or 4.	Open type, Motor controllers
ESB25, followed by -0, -1, -2, -3, or -4, followed by 0, 1, 2, 3, or 4 followed by N	Open type, Motor controllers
ESB40, followed by -0, 1, 2, 3 or 4, followed by 0, 1 or 2, may be followed by N, may be followed by -DC-B or E.	Open type, Motor controllers
ESB63, followed by -0, 1, 2, 3 or 4, followed by 0, 1 or 2, may be followed by N, may be followed by -DC-B or E.	Open type, Motor controllers



David Piecuch
UL Mark Certification Program Manager

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CERTIFICATE NUMBER	20-2040577-PDA
EFFECTIVE DATE	16-Oct-2020
EXPIRY DATE	15-Oct-2025
ABS TECHNICAL OFFICE	Hamburg Engineering Department

CERTIFICATE OF Product Design Assessment

This is to certify that a representative of this Bureau did, at the request of

ABB STOTZ KONTAKT GMBH

located at

EPPELHEIMER STR. 82, HEIDELBERG, Germany, D-69123

assess design plans and data for the below listed product. This assessment is a representation by the Bureau as to the degree of compliance the design exhibits with applicable sections of the Rules. This assessment does not waive unit certification or classification procedures required by ABS Rules for products to be installed in ABS classed vessels or facilities. This certificate, by itself, does not reflect that the product is Type Approved. The scope and limitations of this assessment are detailed on the pages attached to this certificate.

Product Motor Protection Circuit Breaker

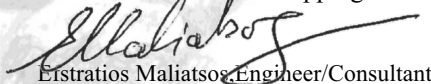
Model MS116-xxx

This Product Design Assessment (PDA) Certificate remains valid until 15/Oct/2025 or until the Rules and/or Standards used in the assessment are revised or until there is a design modification warranting design reassessment (whichever occurs first).

Acceptance of product is limited to the "Intended Service" details prescribed in the certificate and as per applicable Rules and Standards.

This Certificate is valid for installation of the listed product on ABS units which exist or are under contract for construction on or previous to the effective date of the ABS Rules and standards applied at the time of PDA issuance. Use of the Product for non-ABS units is subject to agreement between the manufacturer and intended client.

American Bureau Of Shipping


Eustratios Maliatsos, Engineer/Consultant

NOTE: This certificate evidences compliance with one or more of the Rules, Guides, standards or other criteria of ABS or a statutory, industrial or manufacturer's standards. It is issued solely for the use of ABS, its committees, its clients or other authorized entities. Any significant changes to the aforementioned product without approval from ABS will result in this certificate becoming null and void. This certificate is governed by ABS Rules 1-1-A3/5.9 Terms and Conditions of the Request for Product Type Approval and Agreement (2010)



CERTIFICATE NUMBER
EFFECTIVE DATE
EXPIRY DATE
ABS TECHNICAL OFFICE

20-2040577-PDA-DUP
16-Oct-2020
15-Oct-2025
Hamburg Engineering Department

CERTIFICATE OF Product Design Assessment

This is to certify that a representative of this Bureau did, at the request of

ABB XINHUI LOW VOLTAGE SWITCHGEAR COMPANY LTD

located at

**NO. 9, NORTH SANHE ROAD, XINHUI DISTRICT, JIANGMEN CITY,
China, 529100**

assess design plans and data for the below listed product. This assessment is a representation by the Bureau as to the degree of compliance the design exhibits with applicable sections of the Rules. This assessment does not waive unit certification or classification procedures required by ABS Rules for products to be installed in ABS classed vessels or facilities. This certificate, by itself, does not reflect that the product is Type Approved. The scope and limitations of this assessment are detailed on the pages attached to this certificate.

Product Motor Protection Circuit Breaker

Model MS116-xxx

This Product Design Assessment (PDA) Certificate remains valid until 15/Oct/2025 or until the Rules and/or Standards used in the assessment are revised or until there is a design modification warranting design reassessment (whichever occurs first).

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This Certificate is valid for installation of the listed product on ABS units which exist or are under contract for construction on or previous to the effective date of the ABS Rules and standards applied at the time of PDA issuance. Use of the Product for non-ABS units is subject to agreement between the manufacturer and intended client.

American Bureau Of Shipping

Efstratios Maliatsos, Engineer/Consultant

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CERTIFICATE OF COMPLIANCE

Certificate Number UL-US-L137861-33721-81210002-2
Report Reference E137861-20001218
Date 24-May-2023

Issued to: ABB Stotz-Kontakt GmbH
Eppelheimer Str 82
Heidelberg, Baden-Wurttemberg 69123
Germany

This is to certify that NLRV - Motor Controllers, Manual
representative samples of See Addendum Page for Product Designation(s).

Have been evaluated by UL in accordance with the
Standard(s) indicated on this Certificate.

Standard(s) for Safety: UL 60947-1, 5th Ed., Issue Date: 2013-7-31, Revision Date:
2019-5-6, UL 60947-4-1, 3rd Ed., Issue Date: 2014-04-04,
Revision Date: 2017-10-17

Additional Information: See the UL Online Certifications Directory at
<https://iq.ulprospector.com> for additional information

This Certificate of Compliance indicates that representative samples of the product described in the certification report have met the requirements for UL certification. It does not provide authorization to apply the UL Mark. Only the Authorization Page that references the Follow-Up Services Procedure for ongoing surveillance provides authorization to apply the UL Mark.

Only those products bearing the UL Mark should be considered as being UL Certified and covered under UL's Follow-Up Services.

Look for the UL Certification Mark on the product.



Deborah Jennings-Conner, VP Regulatory Services

UL LLC

Any information and documentation involving UL Mark services are provided on behalf of UL LLC (UL) or any authorized licensee of UL. For questions, please contact a local UL Customer Service Representative at <http://ul.com/aboutul/locations/>

CERTIFICATE OF COMPLIANCE

Certificate Number UL-US-L137861-33721-81210002-2
Report Reference E137861-20001218
Date 24-May-2023

This is to certify that representative samples of the product as specified on this certificate were tested according to the current UL requirements

Model	Category Description
Accessory, Auxiliary Contacts , CK1, HKF1, and HK1, followed by -02, -11, -20, -01, -10 may be followed by L, may be followed by K, may be followed by A, may be followed by B.	Motor Controllers - Manual
Accessory, Auxiliary Contacts , MAHN, followed by -02, -11, -20, -01, -10, followed by FB, LL or LR.	Motor Controllers - Manual
Accessory, Undervoltage Trip , MARNLLA, Shunt Trip MAANLLA, followed by -20, -24, -48, -60, -110, -208, -230, -400, -415 or -575.	Motor Controllers - Manual
Accessory, Padlock Kit , MAS1	Motor Controllers - Manual
MBS32NG,, followed by -002, -003, -004, -006, -010, -016, -025, -040, -063, -100, -120, -160, -200, -250 or -320.	Motor Controllers - Manual
MS116-0.16,, -0.25, -0.40, -0.63, -1.00, -1.60, -2.5, -4.00, -6.3, -10.0, -12.0, -16.00, -20.0, -25.0 or -32.0.	Motor Controllers - Manual
Accessory, Padlock Kit , SA1, SA3, SA10.	Motor Controllers - Manual
Accessory, Auxiliary Contacts , SK1, followed by -02, -11, -20, -01, -10,, may be followed by AR, may be followed by K, may be followed by A, may be followed by B.	Motor Controllers - Manual
Accessory, Undervoltage Trip , UA1, Shunt Trip AA1, – followed by -20, -24, -48, -60, -110, -208, -230, -400, -415 or -575.	Motor Controllers - Manual



Deborah Jennings-Conner, VP Regulatory Services

UL LLC

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CERTIFICATE OF COMPLIANCE

Certificate Number UL-CA-L137861-33751-81210002-2
Report Reference E137861-20001218
Date 24-May-2023

Issued to: ABB Stotz-Kontakt GmbH
Eppelheimer Str 82
Heidelberg, Baden-Wurttemberg 69123
Germany

This is to certify that NLRV7 - Motor Controllers, Manual Certified for Canada
representative samples of See Addendum Page for Product Designation(s).

Have been evaluated by UL in accordance with the
Standard(s) indicated on this Certificate.

Standard(s) for Safety: CSA C22.2 No. 60947-1, 2nd Ed., Issue Date: 2013-07-01,
CSA C22.2 NO. 60947-4-1, 2nd Ed., Issue Date: 2014-04-
04, Revised 2018-05

Additional Information: See the UL Online Certifications Directory at
<https://iq.ulprospector.com> for additional information

This Certificate of Compliance indicates that representative samples of the product described in the certification report have met the requirements for UL certification. It does not provide authorization to apply the UL Mark. Only the Authorization Page that references the Follow-Up Services Procedure for ongoing surveillance provides authorization to apply the UL Mark.

Only those products bearing the UL Mark should be considered as being UL Certified and covered under UL's Follow-Up Services.

Look for the UL Certification Mark on the product.



Deborah Jennings-Conner, VP Regulatory Services

UL LLC

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CERTIFICATE OF COMPLIANCE

Certificate Number UL-CA-L137861-33751-81210002-2
Report Reference E137861-20001218
Date 24-May-2023

This is to certify that representative samples of the product as specified on this certificate were tested according to the current UL requirements

Model	Category Description
Accessory, Auxiliary Contacts , CK1, HKF1, and HK1, followed by -02, -11, -20, -01, -10 may be followed by L, may be followed by K, may be followed by A, may be followed by B.	Motor Controllers - Manual
Accessory, Auxiliary Contacts , MAHN, followed by -02, -11, -20, -01, -10, followed by FB, LL or LR.	Motor Controllers - Manual
Accessory, Undervoltage Trip , MARNLLA, Shunt Trip MAANLLA, followed by -20, -24, -48, -60, -110, -208, -230, -400, -415 or -575.	Motor Controllers - Manual
Accessory, Padlock Kit , MAS1	Motor Controllers - Manual
MBS32NG,, followed by -002, -003, -004, -006, -010, -016, -025, -040, -063, -100, -120, -160, -200, -250 or -320.	Motor Controllers - Manual
MS116-0.16,, -0.25, -0.40, -0.63, -1.00, -1.60, -2.5, -4.00, -6.3, -10.0, -12.0, -16.00, -20.0, -25.0 or -32.0.	Motor Controllers - Manual
Accessory, Padlock Kit , SA1, SA3, SA10.	Motor Controllers - Manual
Accessory, Auxiliary Contacts , SK1, followed by -02, -11, -20, -01, -10,, may be followed by AR, may be followed by K, may be followed by A, may be followed by B.	Motor Controllers - Manual
Accessory, Undervoltage Trip , UA1, Shunt Trip AA1, – followed by -20, -24, -48, -60, -110, -208, -230, -400, -415 or -575.	Motor Controllers - Manual



Deborah Jennings-Conner, VP Regulatory Services

UL LLC

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BV LCIE
CHINA
Number

N° 2466AS03ASCQ53832

ATTESTATION of conformity with European Directives

Product: Type B RCCB
Reference: EKL1-63B
Issued to: ZHEJIANG ETEK Electrical Technology CO.,LTD.
Address: NO.288, Wei 17th Road; Yueqing Economic Development Zone; 325600
Yueqing, Wenzhou; Zhejiang China
Manufacturer: ZHEJIANG ETEK Electrical Technology CO.,LTD.
1P+N and 3P+N(neutral on right)
Ue=230/240V~ for 1P+N, 400/415V~ for 3P+N; 50/60Hz
In= 16A,20A,25A,32A,40A,63A
Inc=IΔc=10kA
Technical characteristics: Im=IΔm=500 A (In = 16,20,25,32,40 A); 630 A (In = 63 A)
IΔn=30mA; 100mA; 300mA; Grid distance = 50mm
Ui= 415V; Uimp=4kV
Material group=IIa
Screw diameter=4,9mm

The submitted sample of the above equipment has been tested for **CE** marking according to following European Directive and following standards:

Low Voltage Directive 2014/35/EU

Standards	Report number	Report date
EN 62423:2012 used in conjunction with EN 61008-1:2012+A1:2014+A2:2014+A11:2015, EN 61008-2-1:1994 + A11:1998	ASCQ-ESH-P24020665	03/18/2024

The referred test report(s) show that the product complies with standard(s) recognized as giving presumption of compliance with the essential requirements in the specified European Directive

This verification does not imply assessment of the production of the product

The **CE** marking may be affixed if all relevant and effective European Directives with **CE** are applicable

Shanghai (P.R. China), Mar. 21st, 2024.

Charlie CHEN
Product Line Manager



This document shall not be reproduced, except in full, without the written approval of BV LCIE China.
Information given in this document, are related to the tested specimen of the described electrical sample.

IEC SYSTEM FOR MUTUAL RECOGNITION OF TEST CERTIFICATES FOR ELECTRICAL EQUIPMENT
(IECEE) CB SCHEME

CB TEST CERTIFICATE

Product

RCCB, residual current operated circuit-breaker without integral overcurrent protection, functionally independent of line voltage

Name and address of the applicant

ZHEJIANG ETEK Electrical Technology CO.,LTD.
NO.288, Wei 17th Road, Yueqing Economic Development Zone, 325600 Yueqing, Wenzhou, Zhejiang
CHINA

Name and address of the manufacturer

ZHEJIANG ETEK Electrical Technology CO.,LTD.
NO.288, Wei 17th Road, Yueqing Economic Development Zone, 325600 Yueqing, Wenzhou, Zhejiang
CHINA

Name and address of the factory

ZHEJIANG ETEK Electrical Technology CO.,LTD.
NO.288, Wei 17th Road, Yueqing Economic Development Zone, 325600 Yueqing, Wenzhou, Zhejiang
CHINA

Note: When more than one factory, please report on page 2

☐ Additional Information on page 2

Ratings and principal characteristics

Ue : AC 230 V / 240 V (1P+N)
AC 400 V / 415 V (3P+N)

Trademark (if any)



Customer's Testing Facility (CTF) Stage used

Model / Type Ref.

EKL1-63B

Additional information (if necessary may also be reported on page 2)

see further ratings on page 2

☒ Additional Information on page 2

A sample of the product was tested and found to be in conformity with

IEC 61008-1:2010
IEC 61008-1:2010/AMD1:2012
IEC 61008-1:2010/AMD2:2013
IEC 61008-2-1:1990
IEC 62423:2009

As shown in the Test Report Ref. No. which forms part of this Certificate

286311-TL3-1

This CB Test Certificate is issued by the National Certification Body

VDE Prüf- und Zertifizierungsinstitut GmbH

VDE Testing and Certification Institute

Zertifizierungsstelle und internat. Angelegenheiten

Certification Body and internat. Affairs

Date: 2021-12-09

Signature:



R. Nickel

Additional information (if necessary)

Further ratings and principal characteristics:

50/60 Hz

In: 16 A; 20 A; 25 A; 32 A; 40 A; 63 A

I Δ n: 30 mA; 100 mA; 300 mA

Behaviour in presence of d.c. components: Type B

Inc: 10 kA

I Δ m: 500 A (In = 16,20,25,32,40 A); 630 A (In = 63 A)

VDE Prüf- und Zertifizierungsinstitut GmbH
VDE Testing and Certification Institute
 Zertifizierungsstelle und internat. Angelegenheiten
 Certification Body and internat. Affairs

Date: 2021-12-09

Signature:


 R. Nickel

ZEICHENGENEHMIGUNG MARKS APPROVAL

ZHEJIANG ETEK Electrical
Technology CO.,LTD.
NO.288, Wei 17th Road
Yueqing Economic Development Zone
325600 Yueqing, Wenzhou
Zhejiang China

ist berechtigt, für ihr Produkt /
is authorized to use for their product

**Fehlerstromschutzschalter ohne eingebauten
Überstromschutz,netzspannungsunabhängig (RCCB)**
***RCCB, residual current operated circuit-breaker without integral
overcurrent protection, functionally independent of line voltage***

die hier abgebildeten markenrechtlich geschützten Zeichen
für die ab Blatt 2 aufgeführten Typen zu benutzen /
the legally protected Marks as shown below for the types referred to on page 2 ff.



Geprüft und zertifiziert nach /
Tested and certified according to

DIN EN 61008-1 (VDE 0664-10):2018-03; EN 61008-1:2012+A1+A2+A11+A1/AC:2016+A12:2017
DIN EN 61008-2-1 (VDE 0664 Teil 11):1999-12; EN 61008-2-1:1994+A11:1998
DIN EN 62423 (VDE 0664-40):2013-08; EN 62423:2012



Aktenzeichen: 5027864-1720-0001 / 286311

File ref.:

Ausweis-Nr. 40054469

Blatt 1

Certificate No.

Page

Weitere Bedingungen siehe Rückseite und Folgeblätter /
further conditions see overleaf and following pages

Offenbach, 2021-12-09

VDE Prüf- und Zertifizierungsinstitut GmbH
VDE Testing and Certification Institute
Zertifizierungsstelle / Certification

R. Nickel

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Name und Sitz des Genehmigungs-Inhabers / Name and registered seat of the Certificate holder

ZHEJIANG ETEK Electrical Technology CO.,LTD., NO.288, Wei 17th Road, Yueqing Economic Development Zone, 325600 YUEQING, WENZHOU, Zhejiang, CHINA

Aktenzeichen / File ref.

5027864-1720-0001 / 286311 / TL3 / KOH

Datum / Date

2021-12-09

Dieses Blatt gilt nur in Verbindung mit Blatt 1 des Zeichengenehmigungsausweises Nr. 40054469.

This supplement is only valid in conjunction with page 1 of the Certificate No. 40054469.

Fehlerstromschutzschalter ohne eingebauten Überstromschutz,netzspannungsunabhängig (RCCB) RCCB, residual current operated circuit-breaker without integral overcurrent protection, functionally independent of line voltage

Typ(en) / Type(s)

EKL1-63B

Bemessungsspannung <i>Rated voltage</i>	AC 230/240 V (1P+N) AC 400/415 V (3P+N)
Bemessungsstrom <i>Rated current</i>	16 A; 20 A; 25 A; 32 A; 40 A; 63 A
Nennfrequenz <i>Rated frequency</i>	50/60 Hz
Anzahl der Pole <i>Number of poles</i>	1P+N; 3P+N
Bemessungsfehlerstrom <i>Rated residual operating current</i>	30 mA; 100 mA; 300 mA
Bemessungsschaltvermögen <i>Rated making and breaking capacity</i>	630 A (In = 63 A) 500 A (In = 16 A, 20 A, 25 A, 32A,40 A)
Bedingter Bemessungskurzschlussstrom <i>Rated conditional short-circuit current</i>	10 kA
Vorsicherung / Kurzschlusschutzeinricht <i>Fuse / Short-circuit protection device</i>	Silberdraht <i>silver wire</i>
Verhalten bei Gleichstromanteilen <i>Behaviour in presence of d.c. components</i>	Typ B <i>Type B</i>
Umgebungstemperatur <i>Ambient temperature</i>	-25°/+40°C
Anbringungsart <i>Attachment type</i>	Tragschienenmontage <i>DIN rail mounting</i>
Anschlussart <i>Type of termination</i>	Schraubklemmen <i>screw-type terminals</i>

VDE Prüf- und Zertifizierungsinstitut Zeichengenehmigung

Ausweis-Nr. / Beiblatt /
Certificate No. Supplement
40054469

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Aktenzeichen / *File ref.*

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Datum / *Date*

2021-12-09

Dieses Beiblatt ist Bestandteil des Zeichengenehmigungsausweises Nr. 40054469.

This supplement is part of the Certificate No. 40054469.

**Fehlerstromschutzschalter ohne eingebauten
Überstromschutz,netzspannungsunabhängig (RCCB)**
***RCCB, residual current operated circuit-breaker without integral
overcurrent protection, functionally independent of line voltage***

Fertigungsstätte(n)

Place(s) of manufacture

Referenz/*Reference*

30026643

ZHEJIANG ETEK Electrical
Technology CO.,LTD.
NO.288, Wei 17th Road
Yueqing Economic Development Zone
325600 YUEQING, WENZHOU
Zhejiang
CHINA

VDE Prüf- und Zertifizierungsinstitut Zeichengenehmigung

Ausweis-Nr. / Infoblatt /
Certificate No. Info sheet
40054469

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The approval is solely signed on the first page.

	DI		DQ					
	1: K101		1: K201		2: K202		3: K203	
Type	DI 16x24VDC ST		DQ 16x24VDC/0.5A ST		DQ 16x24VDC/0.5A ST		DQ 16x24VDC/0.5A ST	
Module	6ES7 131-6BH01-0BA0		6ES7 132-6BH01-0BA0		6ES7 132-6BH01-0BA0		6ES7 132-6BH01-0BA0	
CPU 1514SP-2 PN 6ES7 514-2DN03-0AB0	.0	.1	.0	.1	.0	.1	.0	.1
	.2	.3	.2	.3	.2	.3	.2	.3
	.4	.5	.4	.5	.4	.5	.4	.5
	.6	.7	.6	.7	.6	.7	.6	.7
	.0	.1	.0	.1	.0	.1	.0	.1
	.2	.3	.2	.3	.2	.3	.2	.3
	.4	.5	.4	.5	.4	.5	.4	.5
	.6	.7	.6	.7	.6	.7	.6	.7
	L	M	L	M	L	M	L	M
	Compressor 1 MB OK	Compressor 2 MB OK	Turn ON compressor 1	Turn ON compressor 2	Temperature Safety Relay	Reserved	Reserved	Heating mat 1
	Vacuum pump 1 MB OK	Reserved	Turn ON vacuum pump 1	Turn ON led red	Reserved	Turn On Evac valve Main	Heating mat 2	Heating mat 3
	Reserved	Reserved	Turn ON led green	Turn ON led blue	Turn On Evac valve 1	Turn On Evac valve 2	Heating mat 4	Heating mat 5
	Supporting Parts Check 1	Supporting Parts Check 2	Open chamber valve 1	Close chamber valve 1	Open chamber valve 2	Close chamber valve 2	Heating mat 6	Heating mat 7
	Reserved	Reserved	Turn ON vacuum valve 1	Turn ON vacuum valve 2	Reserved	Reserved	Heating mat 8	Heating mat 9
	Reserved	Reserved	Turn ON water valve 1	Turn ON water valve 2	Reserved	Reserved	Heating mat 10	Heating mat 11
	Reserved	Reserved	Light	Reserved	Reserved	Reserved	Heating mat 12	Heating mat 13
	Reserved	Reserved	Turn ON oil pump CT 1	Turn ON oil pump CT 2	Reserved	Reserved	Heating mat 14	Heating mat 15
	24V+	0V					24V+	0V

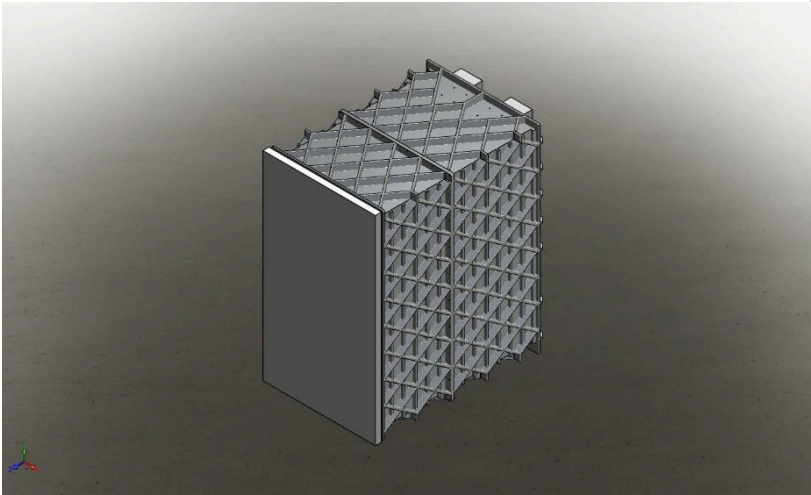
4: K204		5: K205		6: K206		1: K401		2: K402		3: K403		4: K404		5: K
DQ 16x24VDC/0.5A ST		DQ 16x24VDC/0.5A ST		DQ 16x24VDC/0.5A ST		Al 4xRTD/TC 2-/3-/4-Wire HF		Al 4xRTD/TC 2-/3-/4-Wire HF		Al 4xRTD/TC 2-/3-/4-Wire HF		Al 4xRTD/TC 2-/3-/4-Wire HF		Al 4xRTD/TC 2-/3-/4-Wire HF
6ES7 132-6BH01-0BA0		6ES7 132-6BH01-0BA0		6ES7 132-6BH01-0BA0		6ES7134-6JD00-0CA1		6ES7134-6JD00-0CA1		6ES7134-6JD00-0CA1		6ES7134-6JD00-0CA1		6ES7134-6
.0	.1	.0	.1	.0	.1	M0+	M1+	M0+	M1+	M0+	M1+	M0+	M1+	M0+
.2	.3	.2	.3	.2	.3	M2+	M3+	M2+	M3+	M2+	M3+	M2+	M3+	M2+
.4	.5	.4	.5	.4	.5	M0-	M1-	M0-	M1-	M0-	M1-	M0-	M1-	M0-
.6	.7	.6	.7	.6	.7	M2-	M3-	M2-	M3-	M2-	M3-	M2-	M3-	M2-
.0	.1	.0	.1	.0	.1	IC0+	IC1+	IC0+	IC1+	IC0+	IC1+	IC0+	IC1+	IC0+
.2	.3	.2	.3	.2	.3	IC2+	IC3+	IC2+	IC3+	IC2+	IC3+	IC2+	IC3+	IC2+
.4	.5	.4	.5	.4	.5	IC0-	IC1-	IC0-	IC1-	IC0-	IC1-	IC0-	IC1-	IC0-
.6	.7	.6	.7	.6	.7	IC2-	IC3-	IC2-	IC3-	IC2-	IC3-	IC2-	IC3-	IC2-
L	M	L	M	L	M	L	M	L	M	L	M	L	M	L
Heating mat 16	Heating mat 17	Heating mat 32	Heating mat 33	Heating mat 48	Heating mat 49	Reserved	Temp mat 1	Temp. mat 4	Temp. mat 5	Temp. mat 8	Temp. mat 9	Temp. mat 12	Temp. mat 13	Temp. mat 16
Heating mat 18	Heating mat 19	Heating mat 34	Heating mat 35	Heating mat 50	Heating mat 51	Temp. mat 2	Temp. mat 3	Temp. mat 6	Temp. mat 7	Temp. mat 10	Temp. mat 11	Temp. mat 14	Temp. mat 15	Temp. mat 18
Heating mat 20	Heating mat 21	Heating mat 36	Heating mat 37	Reserved	Reserved									
Heating mat 22	Heating mat 23	Heating mat 38	Heating mat 39	Heating mat 52	Heating mat 53									
Heating mat 24	Heating mat 25	Heating mat 40	Heating mat 41	Heating mat 54	Reserved									
Heating mat 26	Heating mat 27	Heating mat 42	Heating mat 43	Heater compressor 1	Heater compressor 2									
Heating mat 28	Heating mat 29	Heating mat 44	Heating mat 45	Heater compressor 3	Heater compressor 4									
Heating mat 30	Heating mat 31	Heating mat 46	Heating mat 47	Reserved	Reserved									
		24V+	0V			24V+	0V							

RTP

[illegible]

[illegible]

					AI	
418	19: K419		20: K420		1: K501	
-/3-/4-Wire HF	AI 4xRTD/TC 2-/3-/4-Wire HF		AI 4xRTD/TC 2-/3-/4-Wire HF		AI 8xU BA	
JD00-0CA1	6ES7134-6JD00-0CA1		6ES7134-6JD00-0CA1		6ES7134-6FF00-0AA1	
M1+	M0+	M1+	M0+	M1+	U0	U1
M3+	M2+	M3+	M2+	M3+	U2	U3
M1-	M0-	M1-	M0-	M1-	U4	U5
M3-	M2-	M3-	M2-	M3-	U6	U7
IC1+	IC0+	IC1+	IC0+	IC1+	M	M
IC3+	IC2+	IC3+	IC2+	IC3+	M	M
IC1-	IC0-	IC1-	IC0-	IC1-	M	M
IC3-	IC2-	IC3-	IC2-	IC3-	M	M
M	L	M	L	M	L	M
Temp. Chamber 2	Temp. mat 49	Temp. mat 50	Temp. mat 53	Temp. mat 54	Pressure Vacuum Chamber	Reserved
Reserved	Temp. mat 51	Temp. mat 52	Reserved	Reserved	CT1 pressure	CT2 pressure
					Pressure Compressor 2 Low	Pressure_Compressor 1 Low
					Pressure Compressor 2 High	Pressure Compressor 1 High



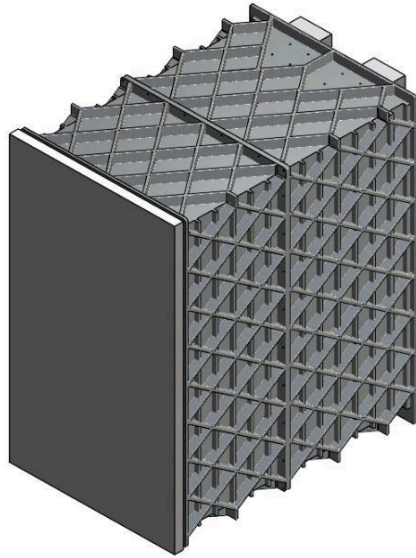
Simulation of IC570 Chamber Test Stress

Table of Contents

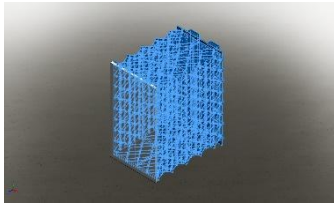
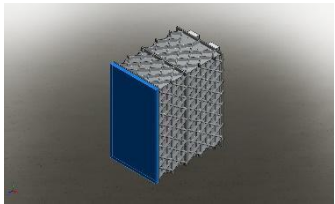
Description	
Assumptions	
Model Information	
Study Properties	
Units	
Material Properties	
Loads and Fixtures	
Connector Definitions	
Contact Information	
Mesh information	
Sensor Details	
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Assumptions

Model Information



Model name: IC570_Chamber_Test Stress
Current Configuration: Default

Document Name and Reference	Treated As	Volumetric Properties
Boss-Extrude9 	Solid Body	Mass:547.067 kg Volume:0.202617 m ³ Density:2,700 kg/m ³ Weight:5,361.25 N
Boss-Extrude7 	Solid Body	Mass:94.3933 kg Volume:0.0793221 m ³ Density:1,190 kg/m ³ Weight:925.054 N

Study Properties

Study name	Static 1
Analysis type	Static
Mesh type	Solid Mesh
Thermal Effect:	On
Thermal option	Include temperature loads

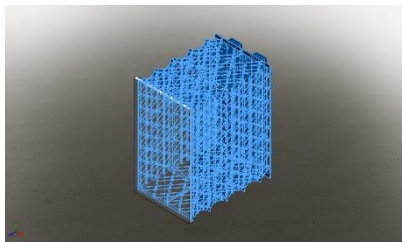
Zero strain temperature	298 Kelvin
Include fluid pressure effects from SOLIDWORKS Flow Simulation	Off
Solver type	FFEPlus
Inplane Effect:	Off
Soft Spring:	Off
Inertial Relief:	Off
Incompatible bonding options	Automatic
Large displacement	Off
Compute free body forces	On
Friction	Off
Use Adaptive Method:	Off

Units

Unit system:	SI (MKS)
Length/Displacement	mm
Temperature	Kelvin
Angular velocity	Rad/sec
Pressure/Stress	N/m ²

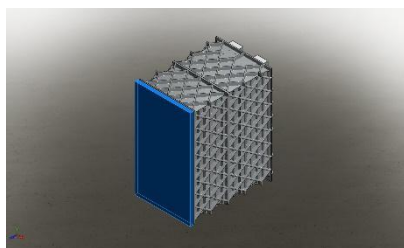
Material Properties

Model Reference	Properties
-----------------	------------



Name:	6061-T6 (SS)
Model type:	Linear Elastic Isotropic
Default failure criterion:	Max von Mises Stress
Yield strength:	2.75e+08 N/m ²
Tensile strength:	3.1e+08 N/m ²
Elastic modulus:	6.9e+10 N/m ²
Poisson's ratio:	0.33
Mass density:	2,700 kg/m ³
Shear modulus:	2.6e+10 N/m ²
Thermal expansion coefficient:	2.4e-05 /Kelvin

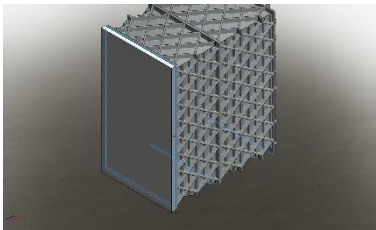
Curve Data:N/A

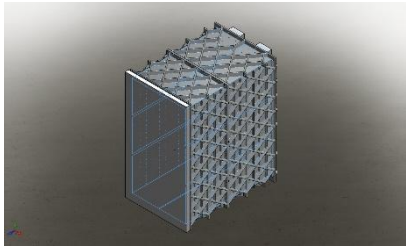


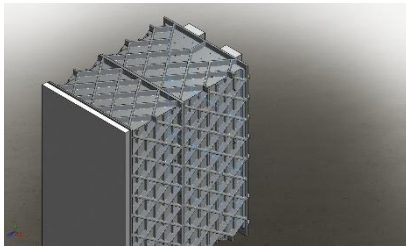
Name: PMMA
Model type: Linear Elastic
 Isotropic
Default failure criterion: Unknown
Tensile strength: $6.1 \times 10^7 \text{ N/m}^2$
Compressive strength: $1.05 \times 10^8 \text{ N/m}^2$
Elastic modulus: $2.77 \times 10^9 \text{ N/m}^2$
Mass density: $1,190 \text{ kg/m}^3$

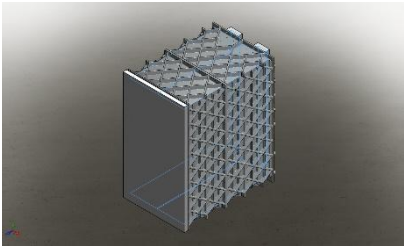
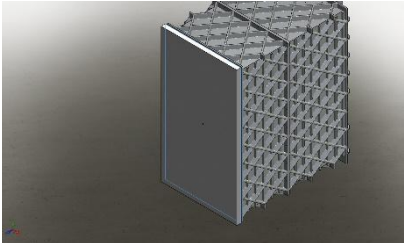
Curve Data:N/A

Loads and Fixtures

Fixture name	Fixture Image	Fixture Details			
Fixed-1		Entities:	3 face(s)		
		Type:	Fixed Geometry		
Resultant Forces					
Components	X	Y	Z	Resultant	
Reaction force(N)	-0.183838	-2,352.88	24,929.8	25,040.6	
Reaction Moment(N.m)	0	0	0	0	

Load name	Load Image	Load Details			
Pressure-1		Entities:	10 face(s)		
		Type:	Normal to selected face		
		Value:	-101,324		
		Units:	N/m^2		
		Phase Angle:	0		
		Units:	deg		

Pressure-2		Entities:	12 face(s)		
		Type:	Normal to selected face		
		Value:	-101,324		
		Units:	N/m^2		
		Phase Angle:	0		
		Units:	deg		

Pressure-3		Entities: 10 face(s) Type: Normal to selected face Value: -101,324 Units: N/m ² Phase Angle: 0 Units: deg
Pressure-4		Entities: 1 face(s) Type: Normal to selected face Value: -101,324 Units: N/m ² Phase Angle: 0 Units: deg

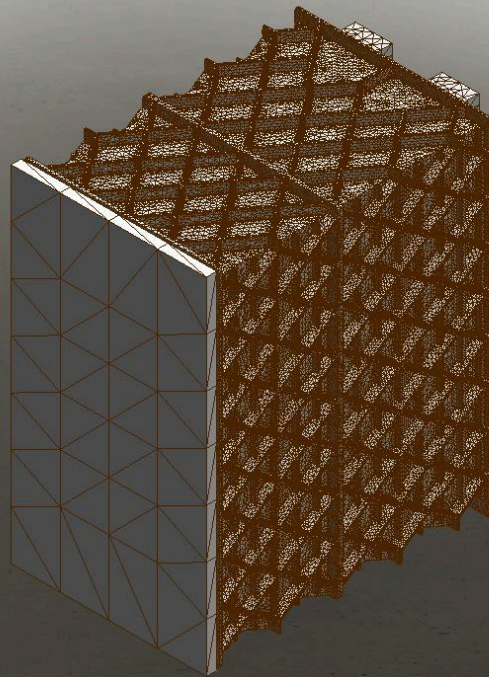
Mesh information

Mesh type	Solid Mesh
Mesher Used:	Standard mesh
Automatic Transition:	Off
Include Mesh Auto Loops:	Off
Jacobian points for High quality mesh	16 Points
Element Size	248.256 mm
Tolerance	12.4128 mm
Mesh Quality	Draft

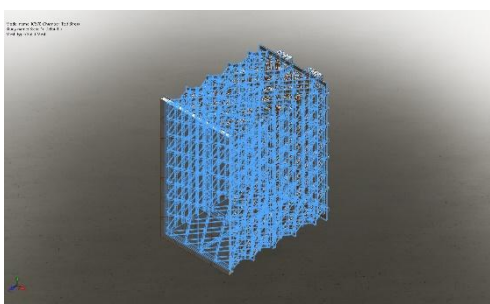
Mesh information - Details

Total Nodes	327239
Total Elements	1249210
Maximum Aspect Ratio	176.42
% of elements with Aspect Ratio < 3	58.4
Percentage of elements with Aspect Ratio > 10	5.7
Time to complete mesh(hh:mm:ss):	00:11:46
Computer name:	

Model name: IC570_Chamber_Test Stress
 Study name: Static 1(-Default-)
 Mesh type: Solid Mesh



Mesh Control Information:

Mesh Control Name	Mesh Control Image	Mesh Control Details
Control-1		Entities: 1 Solid Body (s) Units: mm Size: 107.061 Ratio: 107.061

Resultant Forces

Reaction forces

Selection set	Units	Sum X	Sum Y	Sum Z	Resultant
Entire Model	N	-0.183838	-2,352.88	24,929.8	25,040.6

Reaction Moments

Selection set	Units	Sum X	Sum Y	Sum Z	Resultant
Entire Model	N.m	0	0	0	0

Free body forces

Selection set	Units	Sum X	Sum Y	Sum Z	Resultant
Entire Model	N	9.91232	-2.38988	7.74177	12.8024

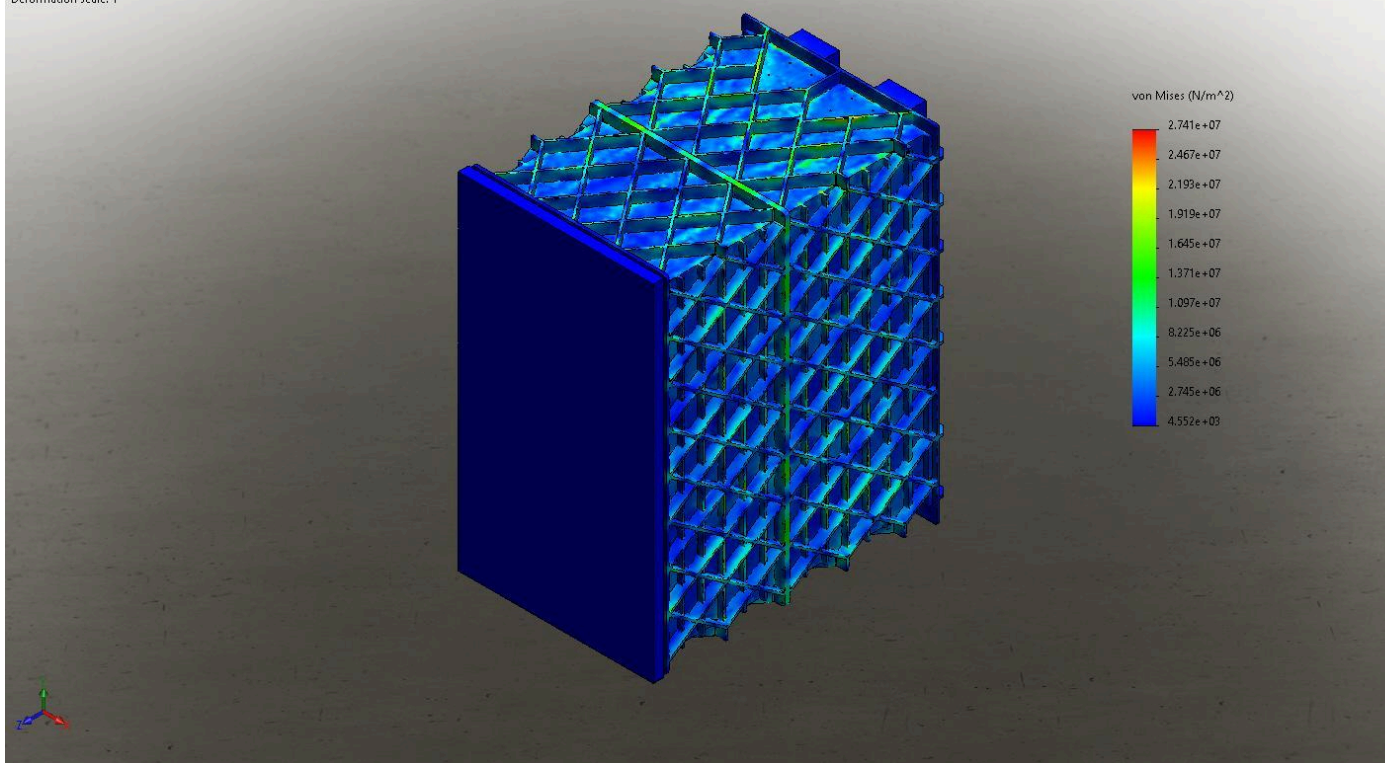
Free body moments

Selection set	Units	Sum X	Sum Y	Sum Z	Resultant
Entire Model	N.m	0	0	0	1e-33

Study Results

Name	Type	Min	Max
Stress1	VON: von Mises Stress	4.552e+03N/m ² Node: 77	2.741e+07N/m ² Node: 21739

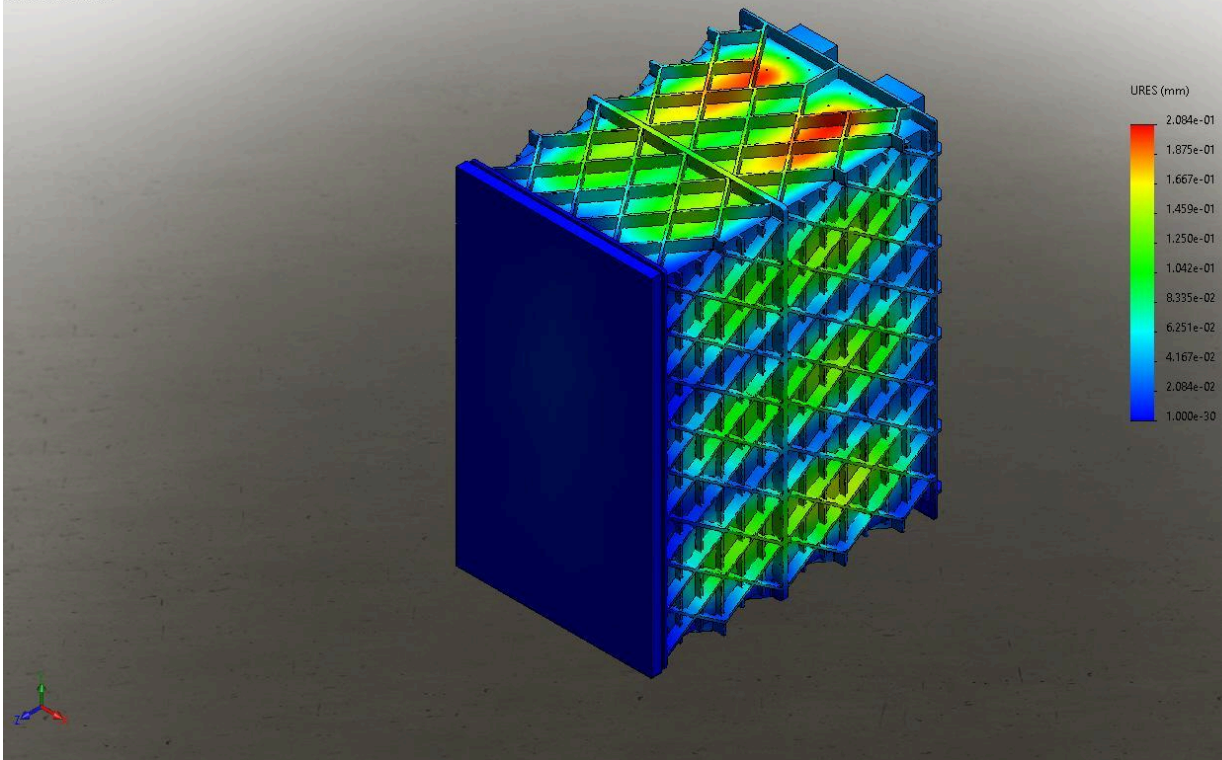
Model name: IC570_Chamber_Test Stress
Study name: Static 1(-Default-)
Plot type: Static nodal stress Stress1
Deformation scale: 1



IC570_Chamber_Test Stress-Static 1-Stress-Stress1

Name	Type	Min	Max
Displacement1	URES: Resultant Displacement	0.000e+00mm	2.084e-01mm

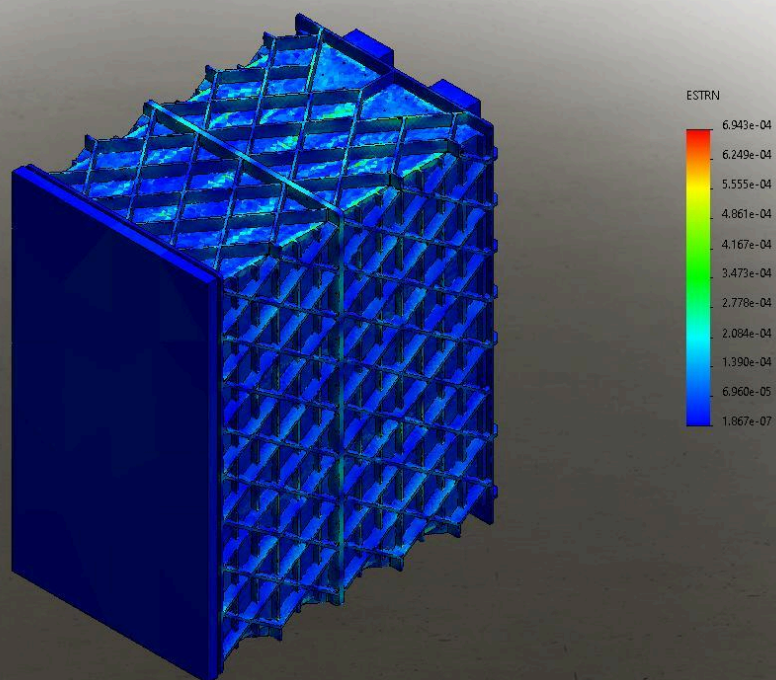
Model name: IC570_Chamber_Test Stress
Study name: Static 1(-Default-)
Plot type: Static displacement Displacement1
Deformation scale: 1



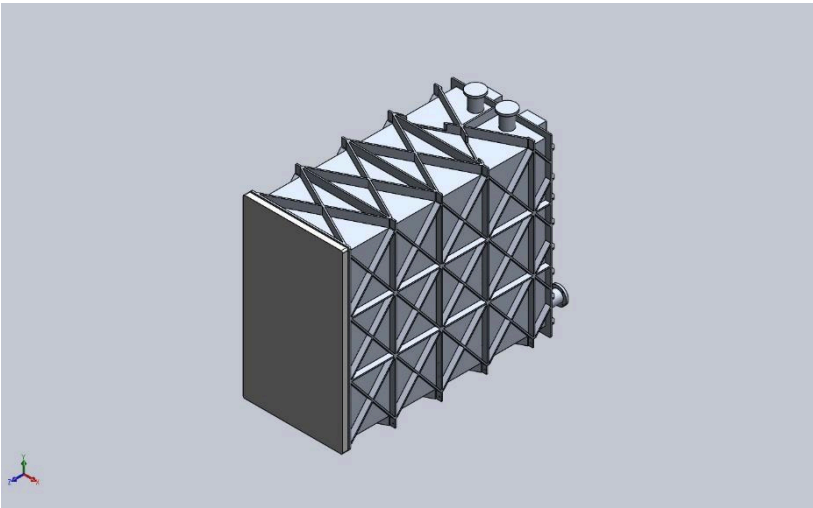
IC570_Chamber_Test Stress-Static 1-Displacement-Displacement1

Name	Type	Min	Max
Strain1	ESTRN: Equivalent Strain	1.867e-07 Element: 828189	6.943e-04 Element: 300454

Model name: IC570_Chamber_Test Stress
Study name: Static 1(-Default-)
Plot type: Static strain Strain1
Deformation scale: 1



IC570_Chamber_Test Stress-Static 1-Strain-Strain1



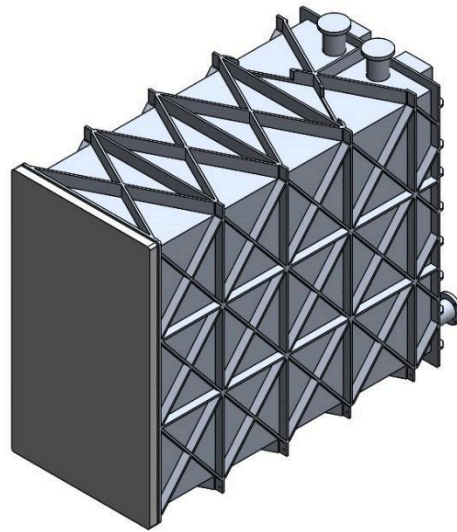
Simulation of IC590_Chamber_Test

Date: Thursday, November 28, 2024
Designer: Solidworks
Study name: Static 3
Analysis type: Static

Table of Contents

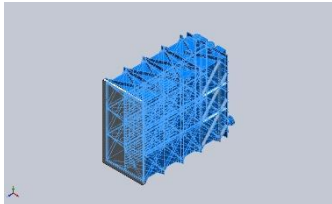
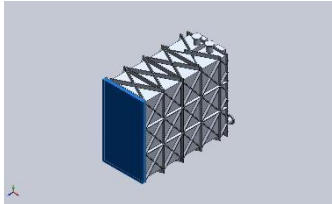
Description	
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Model Information



Model name: IC570_Chamber_Test
Current Configuration: Default

Solid Bodies

Document Name and Reference	Treated As	Volumetric Properties
Mirror8 	Solid Body	Mass:593.789 kg Volume:0.219922 m³ Density:2,700 kg/m³ Weight:5,819.13 N
Boss-Extrude36 	Solid Body	Mass:94.3818 kg Volume:0.0793124 m³ Density:1,190 kg/m³ Weight:924.942 N

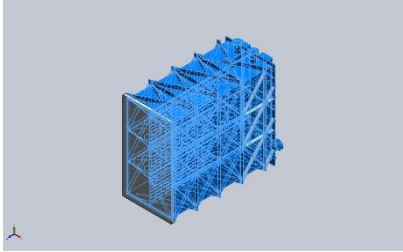
Study Properties

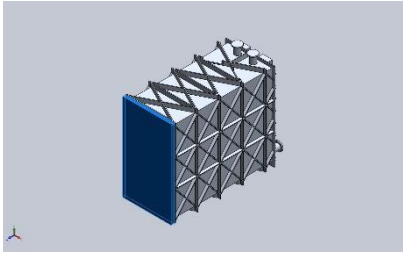
Study name	Static 3
Analysis type	Static
Mesh type	Solid Mesh
Thermal Effect:	On
Thermal option	Include temperature loads
Zero strain temperature	298 Kelvin
Include fluid pressure effects from SOLIDWORKS Flow Simulation	Off
Solver type	FFEPlus
Inplane Effect:	Off
Soft Spring:	Off
Inertial Relief:	Off
Incompatible bonding options	Automatic
Large displacement	Off
Compute free body forces	On
Friction	Off
Use Adaptive Method:	Off

Units

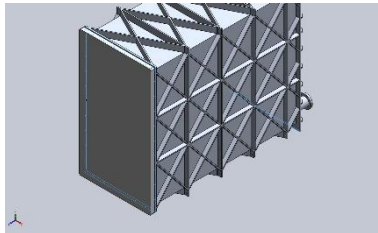
Unit system:	SI (MKS)
Length/Displacement	mm
Temperature	Kelvin
Angular velocity	Rad/sec
Pressure/Stress	N/m ²

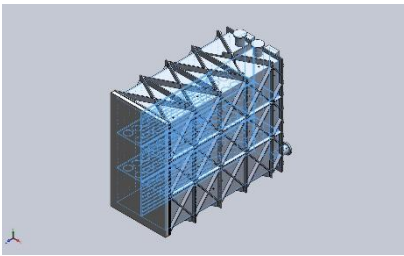
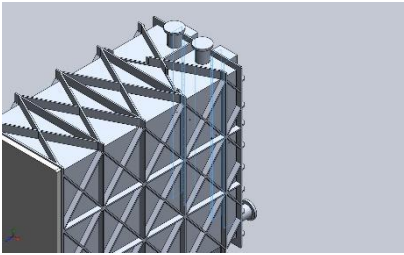
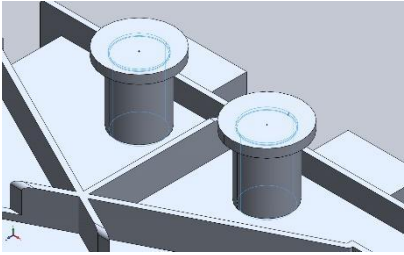
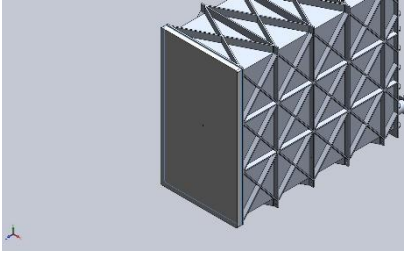
Material Properties

Model Reference	Properties	Components
	Name:	6061-T6 (SS)
	Model type:	Linear Elastic Isotropic
	Default failure criterion:	Max von Mises Stress
	Yield strength:	2.75e+08 N/m ²
	Tensile strength:	3.1e+08 N/m ²
	Elastic modulus:	6.9e+10 N/m ²
	Poisson's ratio:	0.33
	Mass density:	2,700 kg/m ³
	Shear modulus:	2.6e+10 N/m ²
	Thermal expansion coefficient:	2.4e-05 /Kelvin
		SolidBody 1(Mirror8)(IC570_Chamber_ est)

	Name:	PMMA
	Model type:	Linear Elastic Isotropic
	Default failure criterion:	Unknown
	Tensile strength:	6.1e+07 N/m ²
	Compressive strength:	1.05e+08 N/m ²
	Elastic modulus:	2.77e+09 N/m ²
	Mass density:	1,190 kg/m ³
		SolidBody 2(Boss-Extrude36)(IC570_Chamber_Test)

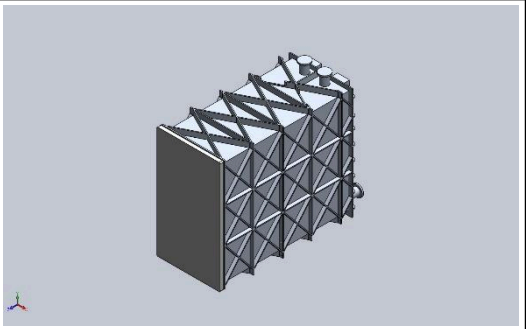
Loads and Fixtures

Fixture name	Fixture Image	Fixture Details			
Fixed-1		Entities:	2 face(s)		
		Type:	Fixed Geometry		
Resultant Forces					
Components	X	Y	Z	Resultant	
Reaction force(N)	56.3685	-9,354.61	32,035.5	33,373.5	
Reaction Moment(N.m)	0	0	0	0	

Load name	Load Image	Load Details
Pressure-1		Entities: 42 face(s) Type: Normal to selected face Value: -101,324 Units: N/m² Phase Angle: 0 Units: deg
Pressure-2		Entities: 7 face(s) Type: Normal to selected face Value: -101,324 Units: N/m² Phase Angle: 0 Units: deg
Pressure-3		Entities: 8 face(s) Type: Normal to selected face Value: -101,324 Units: N/m² Phase Angle: 0 Units: deg
Pressure-4		Entities: 1 face(s) Type: Normal to selected face Value: -101,324 Units: N/m² Phase Angle: 0 Units: deg

Contact Information

Contact	Contact Image	Contact Properties
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Global Contact		Type: Bonded Components: 1 component(s) Options: Incompatible mesh
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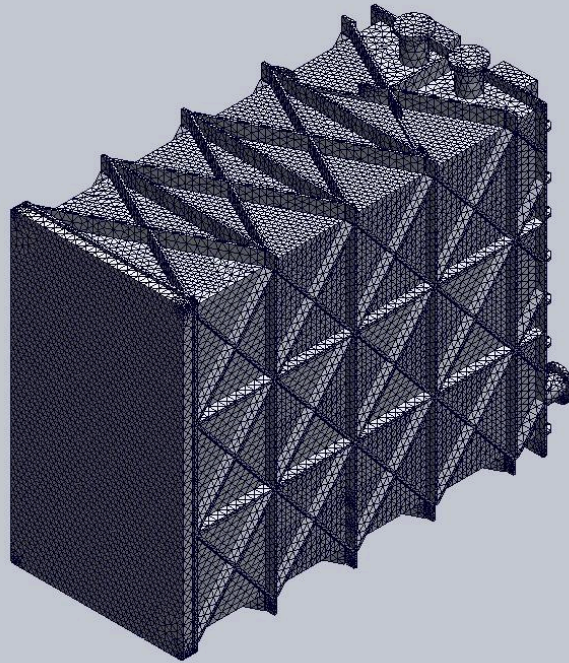
Mesh information

Mesh type	Solid Mesh
Mesher Used:	Standard mesh
Automatic Transition:	Off
Include Mesh Auto Loops:	Off
Jacobian points for High quality mesh	16 Points
Element Size	237.228 mm
Tolerance	11.8614 mm
Mesh Quality	High

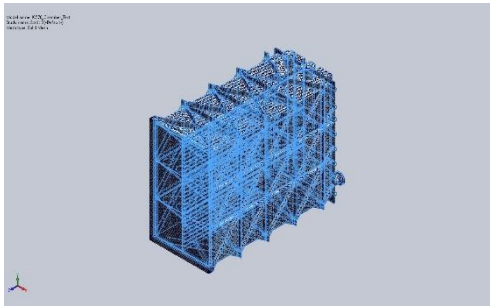
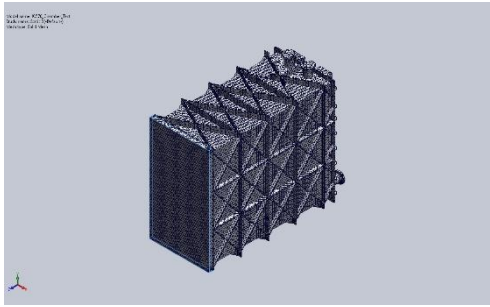
Mesh information - Details

Total Nodes	923412
Total Elements	489428
Maximum Aspect Ratio	296.25
% of elements with Aspect Ratio < 3	49.2
Percentage of elements with Aspect Ratio > 10	4.33
Percentage of distorted elements	0
Time to complete mesh(hh:mm:ss):	00:00:16
Computer name:	

Model name: IC570_Chamber_Test
 Study name: Static 3(-Default-)
 Mesh type: Solid Mesh



Mesh Control Information:

Mesh Control Name	Mesh Control Image	Mesh Control Details
Control-1		Entities: 1 Solid Body (s) Units: mm Size: 36.1 Ratio: 36.1
Control-2		Entities: 1 Solid Body (s) Units: mm Size: 36.9595 Ratio: 36.9595

Resultant Forces

Reaction forces

Selection set	Units	Sum X	Sum Y	Sum Z	Resultant
Entire Model	N	56.3685	-9,354.61	32,035.5	33,373.5

Reaction Moments

Selection set	Units	Sum X	Sum Y	Sum Z	Resultant
Entire Model	N.m	0	0	0	0

Free body forces

Selection set	Units	Sum X	Sum Y	Sum Z	Resultant
Entire Model	N	2.95101	-280.583	-464.366	542.56

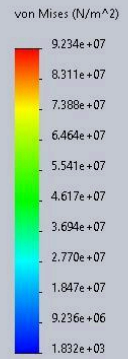
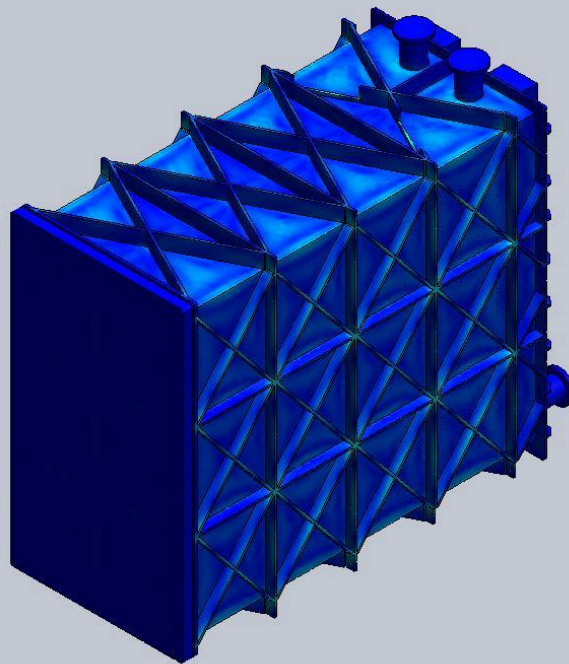
Free body moments

Selection set	Units	Sum X	Sum Y	Sum Z	Resultant
Entire Model	N.m	0	0	0	1e-33

Study Results

Name	Type	Min	Max
Stress1	VON: von Mises Stress	1.832e+03N/m ² Node: 887294	9.234e+07N/m ² Node: 174843

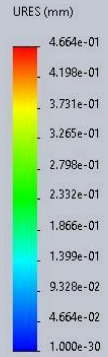
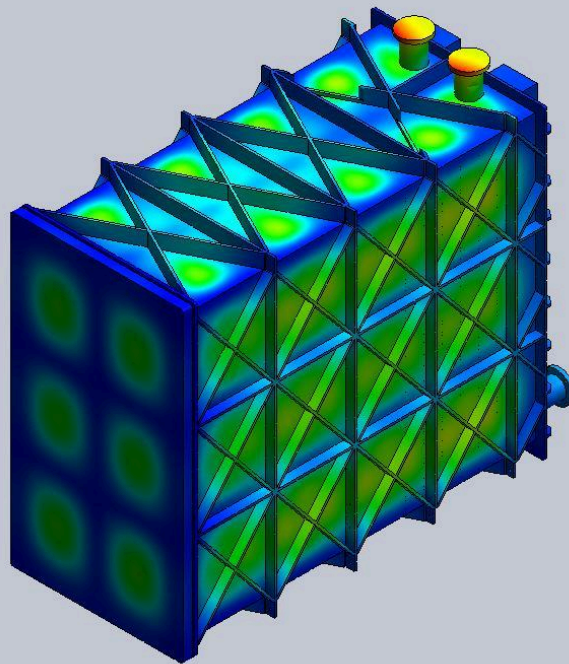
Model name: IC570_Chamber_Test
 Study name: Static 3(-Default-)
 Plot type: Static nodal stress Stress1
 Deformation scale: 1



IC570_Chamber_Test-Static 3-Stress-Stress1

Name	Type	Min	Max
Displacement1	URES: Resultant Displacement	0.000e+00mm Node: 196	4.664e-01mm Node: 198449

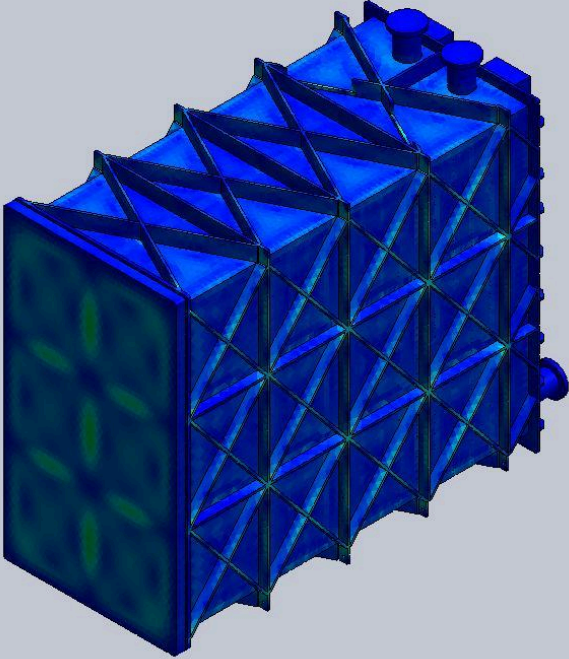
Model name: IC570_Chamber_Test
 Study name: Static 3(-Default-)
 Plot type: Static displacement Displacement1
 Deformation scale: 1



IC570_Chamber_Test-Static 3-Displacement-Displacement1

Name	Type	Min	Max
Strain1	ESTRN: Equivalent Strain	4.334e-08 Element: 90436	9.870e-04 Element: 211480

Model name: IC570_Chamber_Test
Study name: Static 3(-Default-)
Plot type: Static strain Strain1
Deformation scale: 1



IC570_Chamber_Test-Static 3-Strain-Strain1

[Recommended Vacuum Oil for Oil Pumps](#)



EDWARDS **ULTRAGRADE 19** (best option)

EDWARDS **ULTRAGRADE 20**



PETRO CANADA **SUPER VAC Fluid 19** (best option)

PETRO CANADA **SUPER VAC Fluid 20**

[Links for Replacement Relais](#)

FOR MACHINES EQUIPPED WITH PHOENIX RELAIS



[Links for replacement relais](#)

FOR MACHINES EQUIPPED WITH PHOENIX RELAIS



[WAVE Recipes for various materials](#)

GENERAL FRUITS

Strawberry, Mango, Raspberry, Kiwi, Dragonfruit

Pineapple: cut vertical pieces from top to bottom in order to cut through the fibers

Blueberry: difficult to dry, we recommend to cut them or pinch them or alternatively make a smoothie, freeze and dry the smoothie to get a cake

IN PCS TO MAX 6mm thick (prefreeze to -25°C)

Stage 1	3 hrs	-10°C	800 mTorr
Stage 2	3 hrs	0°C	800 mTorr
Stage 3	3 hrs	+10°C	800 mTorr
Stage 4	3 hrs	+20°C	800 mTorr
Stage 5	30 hrs	+40°C	600 mTorr

Material is done when pressure is steady for 2 Hrs below 200mTorr

GENERAL FRUITS

Strawberry, Mango, Raspberry, Kiwi, Dragonfruit

Pineapple: cut vertical pieces from top to bottom in order to cut through the fibers

Blueberry: difficult to dry, we recommend to cut them or pinch them or alternatively make a smoothie, freeze and dry the smoothie to get a cake

IN PCS TO MAX 30 mm thick (prefreeze to -25°C)

Stage 1	5 hrs	-10°C	800 mTorr
Stage 2	5 hrs	0°C	800 mTorr
Stage 3	5 hrs	+10°C	800 mTorr
Stage 4	5 hrs	+20°C	800 mTorr
Stage 5	60 hrs	+40°C	500 mTorr

Material is done when pressure is steady for 2 Hrs below 200mTorr

RASPBERRY HIGH QUALITY (prefreeze to -25°C)

Stage 1	6 hrs	-10°C	800 mTorr
Stage 2	4 hrs	0°C	800 mTorr
Stage 3	4 hrs	+10°C	800 mTorr
Stage 4	4 hrs	+20°C	800 mTorr
Stage 5	30 hrs	+40°C	800 mTorr

Material is done when pressure is steady for 2 Hrs below 200mTorr

ALGEE (prefreeze to -25°C)

Stage 1	3 hrs	-10°C	800 mTorr
Stage 2	3 hrs	0°C	800 mTorr
Stage 3	3 hrs	+10°C	800 mTorr
Stage 4	3 hrs	+20°C	800 mTorr
Stage 5	30 hrs	+40°C	800 mTorr

Material is done when pressure is steady for 2 Hrs below 200mTorr

CANDY no pre freezing necessary

Make sure to place baking paper below and on top to avoid it to stick to the machine

Stage 1	4 hrs	+70°C	600mTorr
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Material is done when pressure is steady for 2 Hrs below 200mTorr

CANNABIS (prefreeze to -25°C)

Stage 1	3 hrs	-10°C	2000 mTorr
Stage 2	3 hrs	0°C	2000 mTorr
Stage 3	3 hrs	+10°C	2000 mTorr
Stage 4	3 hrs	+20°C	2000 mTorr
Stage 5	30 hrs	+25°C	2000 mTorr

We recommend a limiting valve to control the minimum pressure which should not be below 2000 mTorr

Material is done when pressure is steady for 2 Hrs below 200mTorr

CANNABIS (fresh/ unfrozen)

Stage 1	3 hrs	+ 10°C	2000 mTorr
Stage 2	3 hrs	+ 15°C	2000 mTorr
Stage 3	3 hrs	+ 20°C	2000 mTorr
Stage 4	3 hrs	+ 25°C	2000 mTorr
Stage 5	8 hrs	+ 35°C	2000 mTorr

We recommend a limiting valve to control the minimum pressure which should not be below 2000 mTorr

Material is done when pressure is steady for 2 Hrs below 200mTorr

COFFEE (prefreeze to -25°C)

Produce a thick coffee, espresso ideally with little water

Stage 1	5 hrs	+10°C	800 mTorr
Stage 2	5 hrs	+20°C	800 mTorr
Stage 3	30 hrs	+60°C	800 mTorr

Material is done when pressure is steady for 2 Hrs below 200mTorr

We recommend to use a maximal thickness of 15 mm per tray

FISH, SHRIMP

IN PCS TO MAX 20 mm thick (prefreeze to -25°C)

Stage 1	3 hrs	-10°C	800 mTorr
Stage 2	3 hrs	0°C	800 mTorr
Stage 3	3 hrs	+10°C	800 mTorr
Stage 4	3 hrs	+20°C	800 mTorr
Stage 5	30 hrs	+40°C	600 mTorr

Material is done when pressure is steady for 2 Hrs below 200mTorr

HERBS, BASIL etc. (pre freeze or fresh)

Stage 1	3 hrs	+ 10°C	1200 mTorr
Stage 2	3 hrs	+ 15°C	1200 mTorr
Stage 3	3 hrs	+ 20°C	1200 mTorr
Stage 4	3 hrs	+ 25°C	1200 mTorr
Stage 5	8 hrs	+ 35°C	1200 mTorr

Material is done when pressure is steady for 2 Hrs below 200mTorr

Herbs can also be dried without pre freezing, just using fresh plants

HONEY Mix with water first: 10% honey/ 90% water (prefreeze to -30°C)

Stage 1	10 hrs	-10°C	1500 mTorr
Stage 2	10 hrs	0°C	1500 mTorr
Stage 3	10 hrs	+10°C	1500 mTorr
Stage 4	10 hrs	+20°C	1500 mTorr
Stage 5	30 hrs	+30°C	1500 mTorr

Material is done when pressure is steady for 2 Hrs below 200mTorr

Difficult to dry, times may be much longer than indicated

Make sure to place baking paper below and on top to avoid it to stick to the machine

IMPORTANT ALTERNATIVE

Add 40% Maltodextrin to the weight of the honey, this will enable you to produce a more stable product in the form of a firm crunchy foam

MEALS (prefreeze to -25°C)

Stage 1	5 hrs	+10°C	800 mTorr
Stage 2	5 hrs	+20°C	800 mTorr
Stage 3	30 hrs	+40 to 50°C	800 mTorr

Material is done when pressure is steady for 2 Hrs below 200mTorr

We recommend to use a maximal thickness of 30 mm per tray

Try to use as little fat as possible, ideally below 10%

MILK, JUICES, (prefreeze to -25°C)

Stage 3	7 hrs	+10°C	800 mTorr
Stage 4	7 hrs	+20°C	800 mTorr
Stage 5	30 hrs	+40°C	800 mTorr

Material is done when pressure is steady for 2 Hrs below 200mTorr

We recommend to use a maximal thickness of 15mm per tray

MUSHROOMS (fresh/ unfrozen)

Stage 1	3 hrs	+10°C	800 mTorr
Stage 2	3 hrs	+20°C	800 mTorr
Stage 3	10 hrs	+40°C	800 mTorr

Material is done when pressure is steady for 2 Hrs below 200mTorr

Alternatively can also be dried without prefreezing, just using fresh mushrooms

POTATO (fresh/ unfrozen)

Stage 1	3 hrs	+10°C	800 mTorr
Stage 2	3 hrs	+20°C	800 mTorr
Stage 3	20hrs	+40°C	800 mTorr

Material is done when pressure is steady for 2 Hrs below 200mTorr

TEA (prefreeze to -25°C)

Produce a thick tea with little water

Stage 1	5 hrs	+10°C	800 mTorr
Stage 2	5 hrs	+20°C	800 mTorr
Stage 3	30 hrs	+60°C	800 mTorr

Material is done when pressure is steady for 2 Hrs below 200mTorr

We recommend to use a maximal thickness of 15 mm per tray

Alarms, Warnings & Troubleshooting

ALARM 1:

The CPU or some PLC module is faulted

Check1 if all cables on the CPU module (this is the first module on the left and top of the PLC) are attached correctly and not lose

Check 2 if all Simatic units are still well connected to each other (they have a connection horizontally between them), if you see a gap between modules press them together

Check 3 if the temperature sensors are connected correctly, check for loose cables and red lights next to sensors which indicate problems at the sensor connection

ALARM 2:

CPU execution time fault

Requires intervention through the Wave service team

ALARM 9 to 26:

Temperature sensor fault

Check 1 if the sensor at the module on the CPU is attached correctly

Check 2 if the sensor cable is well-connected inside the analog Siemens Simatic module

Check 3 if the cable itself is damaged inside the chamber or outside the chamber leading to the PLC box

ALARM 31 to 84

Drawer 1 to Drawer 54 temperature sensor fault

Check 1 inspect connections of sensors to the PLC, they are connected at the analogue module.

Check 2 if the drawer plug has bent pins.

ALARM 90, 95 & 96:

Vacuum sensor fault

Check 1 connections of the cables from the sensor at the PLC.

Check 2 if the cable is connected correctly to the sensor (it must be attached and screwed to the sensor)

Check 3 if the sensor is very cold this alarm can happen; there should be no condensation or ice on the sensor and it should be connected

Check 4 remove the sensor to see if there is dirt

Check 5 clean the sensor by removing the sensor and using 99.99% alcohol to clean, fill the sensor full with alcohol and remove the alcohol, you can repeat this for up to 3 times. Let the sensor dry for some hours and try again to get proper readings.

Check 6 if your unit has a Thyracont sensor: put the machine on, remove the two rubber closures on top of

ALARM 200&201:
Compressors motor fault

the sensor and press ADJ for about 10 seconds to calibrate the sensor to atmospheric pressure.

(If you are drying powders we recommend to use a manual slow evacuation module to avoid contamination of the sensor)

Check 1 check the temperature of the compressor, it should not be colder than 20°C when starting it.

Check 2 check on the motorbreaker to what AMP the Motorbreaker is set, it should be set to the max (25 A)

Check 3 restart the motor breaker in the PLC by turning it all the way to the left first, then to the right and then put it to *on* again.

Check 4 stop the machine and restart

ALARM 202:
Vacuum pump fault

Check 1 if you have an oil vacuum pump, check the temperature of the pump, if it's cold (below 20°C) use a fan to warm it up

Check 2 restart the pump by manual operation from the control menu

Check 3 restart the motor breaker in the PLC by turning it all the way to the left first, then to the right to put it to *on* again.

Check 4 see if the pump is to *manual off* in the control section on the touch screen

Check 5 see if the pump is well connected to the electricity of the machine

Check 6 stop the machine and restart

Check 7 stop the machine and exchange the pump relais

ALARM 210:
Vacuum pump stopped because it could not generate vacuum

TROUBLESHOOT 210:
Machine does not reach a high vacuum

Check 0 the chamber must always be at least at -20°C when trying to achieve a high vacuum; otherwise water will enter the pump and prevent proper vacuum achievement

Check 1 if the drain, automated evacuation valve is closed using "the manual off" option in the control menu

Check 2 whether the automated drain evacuation valve is closed properly and is not clogged with dirt

Check 3 whether the pump is connected correctly and all connections are closed

Check 4 if the vacuum valve between pump and chamber is open

Check 5 whether the door is properly closed and both fittings are free of dirt

Check 6 the load in the chamber, if the maximum capacity of 25 kg for FD260 or 60 kg for FD440 is exceeded, it will be difficult to achieve a vacuum, especially with porous, powdery or large-surface material

Check 7 The temperature of the material in the chamber, the initial temperature should not exceed -20°C. Make sure your material is completely frozen and has not melted during the loading process

(To check if the vacuum problem is in the chamber or a problem with the pump, run the pump for about 30 minutes, then close the valve on the pump and stop the pump. After 10 minutes, an empty chamber at -20°C should not lose more than 700 mTorr of pressure or 1 mBar).

Alarm 109, 110, 131 to 184:
Overtemperature of the heating mats & Ambient Temperature

Check 1 Check if the maximum temperature to shut off the drawers is too close to the chosen temperature from the recipe, you should have at least 10°C difference

Check 2 if the temperature indicated on the HMI for the drawer seems correct, otherwise the cables could be loose and cause malreading

Alarm 211 & 220
Overtemperature Fault & TSR fault

Check 1 If the problem occurs with several mats, identify the mat with the highest temperature; switch off the machine and disconnect the mat.

Check 2 if the temperature indicated on the HMI for the drawer seems correct, otherwise the cables could be loose and cause malreading

Check 3 Check if the maximum temperature to shut off the drawers is too close to the chosen temperature from the recipe, you should have 10°C difference

WARNING 46:
Close door before production

WARNING 48:
Door not closed

Alarm 215:
Machine cannot reach vacuum setpoint

Alarm 214:
Machine cannot reach cooling setpoint

Check 1 whether the door is closed

Check 2 if the sensor reacts to a metal (test with any metal if the sensor changes its state either on itself - behind the front plate) if it tests positive unlock the threads of the sensors and move it forward closer to the door

Check 3 if the sensor does not react, check if there is a light at the sensor, if not check if the sensor is connected to the cable which should be screwed onto the sensor

Override the sensor can be overridden by putting it to manual *on* in the control board menu

Refer to troubleshooting of ALARM 210

This refers to the setpoint in the menu “settings”, its warning if the setpoint cannot be reached after 20 minutes. Change the settings to a higher value or check as follows:

Check 1 check the bubbleglas of the compressor; if there are any bubbles after some hours of operation and/or on a regular base, this would indicate loss of refrigerant and a potential leak, in this case contact WAVE support or contact directly an HVAC technician to control the cooling system.

Check 2 the ambient temperature should not exceed 23°C.

Check 3 any areas of strong condensation building; large blocks of ice can build over time from condensation and cause temperature dispersion and loss of performance

Check 4 in the settings if the low setting point is set low enough for the system to perform well; the system needs at least a 20°C difference between the chamber temperature and the lowest heating temperature of the drawer.

Alarm 91 to 94:
High & Low Pressure sensor fault

Check 1 if the sensor cables are plugged correctly into the PLC.

Check 2 If the connection is plugged well onto the sensor (screwed in).

TROUBLESHOOT 1:
Breakers of energy supply went off

Check 1 if it is this the first time you branche the machine to your supply, contact the Wave support team

Check 2 if this happened after the machine was running fine, check if any other machine in your premises started working at the moment of the break or if any machine was scheduled to start at the moment of the break as the combined use might be too much

Check 3 unplug the plug and inspect if there are any melted points or if the plug did run hot

Check 4 check if any of the sirius breakers went off and inspect the connected machines, compressor and vacuum pump for heat, damage, smell of molten metal or plastics

Check 5 if **check 2** was positive or no other issue shows up go to the settings page and reduce the maximum energy draw of the machine (0W means maximum, any other value will set the maximum accordingly)

Check 6 if this is not helping or you are unsure contact the Wave support team

TROUBLESHOOT 2:
Breakers at the machine went off

Check 1 contact the Wave support team

TROUBLESHOOT 4:
Condensation at the machine

Check 1 if condensation happens on the door while freezing this is normal, the machine is not designed to be used for freezing over long periods of time

Check 2 if condensation is happening at the front of the machine, make sure the isolation is intact in the inner ring, it can be inspected from inside the machine looking to the front plate

Check 3 if there is condensation in the back of the machine, make sure the isolation is fine at the pipes of the cooling system and the connections

TROUBLESHOOT 5:
Collapsed material

Check 1 make sure the material was at least at -25°C or at lower temperature when it was placed in the machine

Check 2 make sure that you immediately put the machine to vacuum or let it run until drawers reach -20°C before starting the drying process

Check 3 make sure that the drying steps are not too steep, start at least at -10°C and try first steps of 5°C, if this is not working start at -15°C

Check 4 make sure the pieces for drying are not larger than 20mm in diameter or thickness

Check 5 make sure the material is prepared correctly, some fruits must be cut in special ways, some must be pre-treated, general rules are:

Fibrous fruits such as pineapple or citrus fruits must be cut in the way that the fiber will be as short as possible. For pineapple this means cutting not in slices through the stem but in pieces along the stem. For citrus fruits means to cut north along the natural slices but through them to cut open as many cells as possible

Fruits/berries with a skin must be cut or pre-treated to overcome water containing characteristics of the skin. Blueberries are ideally frozen to 0 to 3°C and then cut in half then refrozen to -25°C and dried.

As honey has a very low freezing temperature it is usually mixed with water to raise the freezing temperature.

TROUBLESHOOT 6:
Wet material

Check 1 increase end-temperature and drying time when drying,

Check 2 make sure the vacuum is at least at 200 mTorr and has at least not decreased anymore for 2 hrs (when running a full machine) before the ending of the drying cycle; when the machine is not full this becomes difficult to predict

TROUBLESHOOT 7:
Very long drying times

Check 1 if your final drying temperature is below +40°C; drying times can increase exponentially, sometimes up to a week; try to use higher end-temperature; make sure you reach a vacuum of at least 1 Mbar with a full machine

Check 2 make sure your material is very well frozen through fully when you put it into the machine

Check 3 make sure the pump is performing well and

TROUBLESHOOT 8:
Uneven drying over drawers

TROUBLESHOOT 9:
Evacuation valve not working

TROUBLESHOOT 10:
Powder is contaminating the machine

take if the ballast is fully open

Check 4 check the performance of the compressor, if the chamber temperature is higher than -25°C the performance will decrease substantially, this might be connected to high ambient temperature or to performance issues with the compressor

Check 1 fill drawers evenly, especially if drawers (or shelves with more than one drawer) are only filled in the front of the machine the machine cannot work properly as the sensors for the drawers are in the back of the machine. To avoid this make sure the trays in the back are always loaded.

Check 1 if there is any debris left inside the evacuation valve that stops it from closing properly

Check 2 after some time the valve can deep discharge, therefore put the valve to “*manual on*” in the control menu and leave it to charge in this way for 10 minutes

Check 1 use an additional manual valve to evacuate the chamber slowly to avoid that powder is dispersed all over the chamber

Workaround after drying open one of the clamps in the back of the machine leading from the chamber to the pump until air is sucked inside

Take a look at our tutorial videos on youtube



Comprehensive Risk Assessment Table in Accordance with Machinery Directive 2006/42/EC and Machinery Regulation (EU) 2023/1230 – Covering All Physical and Cyber Hazards

TYPE	HAZARD	RISK MACHINE/HUMAN	SAFETY IN PLACE	FURTHER BY OPERATOR
ELECTRIC HEATING	Overheating of the heating mats placed on the coldtraps for defrosting	x) Burns to the skin x) Irritation of eyes x) Irritation from inhaling smoke xx) Melting of the isolation xx) Melting of the heater itself x) Minor smoke development from the isolation	Separate logic stops the heating at a max temperature of 60°C Mechanical bimetal switches on the heaters to stop heating at 90°C	x) Installation of smoke detectors in the room where machine is located x) Installation of sprinklers in the room where machine is located xx) Video surveillance of the machine xxx) Not leaving the machine unattended
ELECTRIC HEATING	Overheating of the heating mats placed inside the machine	x) Burns to the skin x) Irritation of eyes x) Irritation from inhaling smoke x) Melting of the heater itself xx) Damage to the machines internal matts and cables	PLC logic stops the heating at a max temperature of 85°C ABB Safety switches avoid getting stuck in the "ON" position Safety Circuit that turns off power to all heating matts if one reaches temperature over 85°C. During normal operation the matts require a vacuum to be switched on, avoiding good temperature transfers to other parts	x) Installation of smoke detectors in the room where machine is located x) Installation of sprinklers in the room where machine is located xx) Video surveillance of the machine xxx) Not leaving the machine unattended
HVAC	Increase of pressure/heat in the cooling system	x) Burns to the skin from the hot surface x) Damage to the compressor x) Leak of the system	- SE-B1 thermal protection module with PTC sensors integrated into the analog safety circuit - DELTA-P II differential pressure monitoring in analog safety circuit with automatic lockout - High-pressure switch (32 bar) cuts power via analog safety loop - Motor breaker (max 25A) - Two pressure sensors via PLC trigger shutoff if pressure >32 bar or <0 bar for 15 min	x) Regular check and cleaning of the condensers from dust x) Yearly check of the cooling system
HVAC	Leak of the cooling system	x) Burns to the skin from the hot surface x) Damage to the compressor x) Leak of the system	Bubbleglas installed to check if system is filled with refrigerant	x) Check on performance loss over time
HVAC	Hot & cold parts of the cooling system	x) Burns to the skin from the hot surface	Material is Isolated Warning labels	x) Safety training
HVAC	Moving parts (fans) of the cooling system	x) Injuries to the fingers	- Fan covered with metal guard/shroud	x) Safety training
VACUUM	Touching open parts of the machine when the vacuum	x) Injuries to the skin and fingers	Warning labels	x) Safety training

	pump is on			
VACUUM	Oil shooting from the oil filter of oil based vacuum pumps	x) Risk of contact with skin and eyes, slippery floor	Warning labels	x) Safety training
MECHANICAL	Finger between door and panel	x) Injuries to the skin and fingers	Industrial standard gap existent between door and panel	x) Safety training
PUMP	Oil leakage	x) Risk of contact with skin and eyes, slippery floor		x) Safety training
MACHINE MOVEMENT	Machine moves without notice or intention	x) Injuries x) Damage to other parts in the room	Fixable wheels, additional fixed stand can be retracted additional to the wheels	x) Make sure the floor is flat
ELECTRICAL	Short circuiting of electrical components	x) Damage to unit xxx) Fire	Overcurrent device (Circuit breaker)	x) Yearly test of circuit breaker for proper function by qualified person
ELECTRICAL	Electrocution due to contact with live electrical components	xx) Burns xxx) Electrocution	Safety Switch (FI)	x) Yearly test of FI for proper function by qualified person x) Wear proper shoes x) Wear rubber electrical insulating gloves when inspecting live electrical and electronic parts
ELECTRICAL	Water ingress to main isolating switch	x) Short circuit to earth xx) Electrocution	IP 44 rated switch	x) Do not operate unit near sources of water including taps and hoses
ELECTRICAL	Live parts	x) Electrocution	Installation of earthing points to metal chassis and removable metal tray housing	x) Conduct yearly earthing continuity test to metal components on unit
ELECTRICAL	Overheating of compressors	x) Damage to compressor	Installation of over temperature cut out switch and dedicated motor breaker (overcurrent device)	x) Remain vigilant to excessive heat from compressor
ELECTRICAL	Overheating of vacuum pump	x) Damage to vacuum pump	Installation of over temperature cut out switch and dedicated motor breaker (overcurrent device)	x) Remain vigilant to excessive heat from vacuum pump
ELECTRICAL	Seizure of compressor	x) Damage to compressor	Installation of heating element that heats compressor during cool temperatures	x) Maintain room temperature above 15 degrees celsius
ELECTRICAL	Access to internal parts of unit from unqualified persons	x) Electrocution	Locks on parts that contain electrical control cabinets Warning labels of live parts on access panels of unit	x) Only allow access of internal electrical equipment by qualified persons
CYBERSECURITY	Unauthorized access to networked control systems (PLC, router, HMI, etc.)	xxx) Unintended machine behavior xx) Data theft or system breach x) Loss of monitoring/control access	- ET200SP PLC password protected - Network access only via EXOR router managed by certified external IT company - Password policies for all network components	x) Staff cybersecurity awareness training

Legend:

RISK **MACHINE/HUMAN**

DAMAGE TO HUMANS

xxx) Higher

xx) Medium

x) Lower

DAMAGE TO MACHINE

x) Higher

x) Medium

x) Lower

FURTHER BY OPERATOR

x) Easy to implement xx) Reasonable to implement xxx) Difficult to implement

Machine book

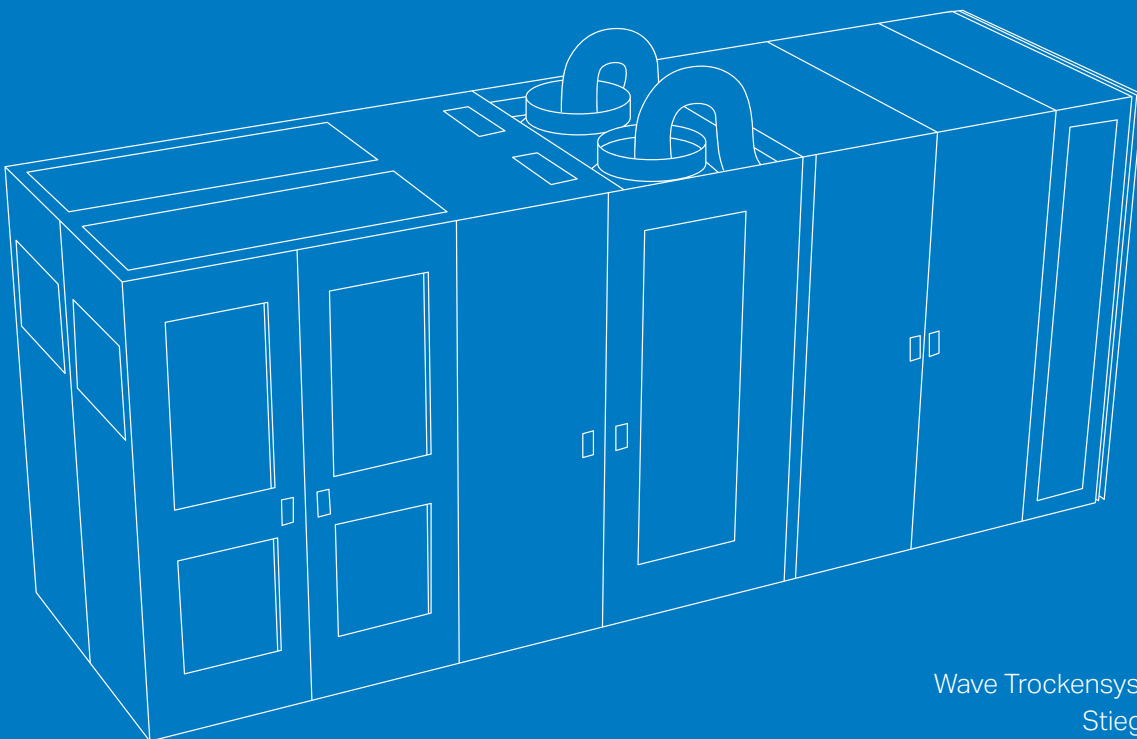
Machine serial number	
Year of manufacture	
Machine model	
Version	
Max warm vacuum	
Max temperature	
Modifications	

Signature manufacturer	
Date & Place	

WAVE IC570MAX

USER MANUAL
2025

WAVE IC590MAX



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