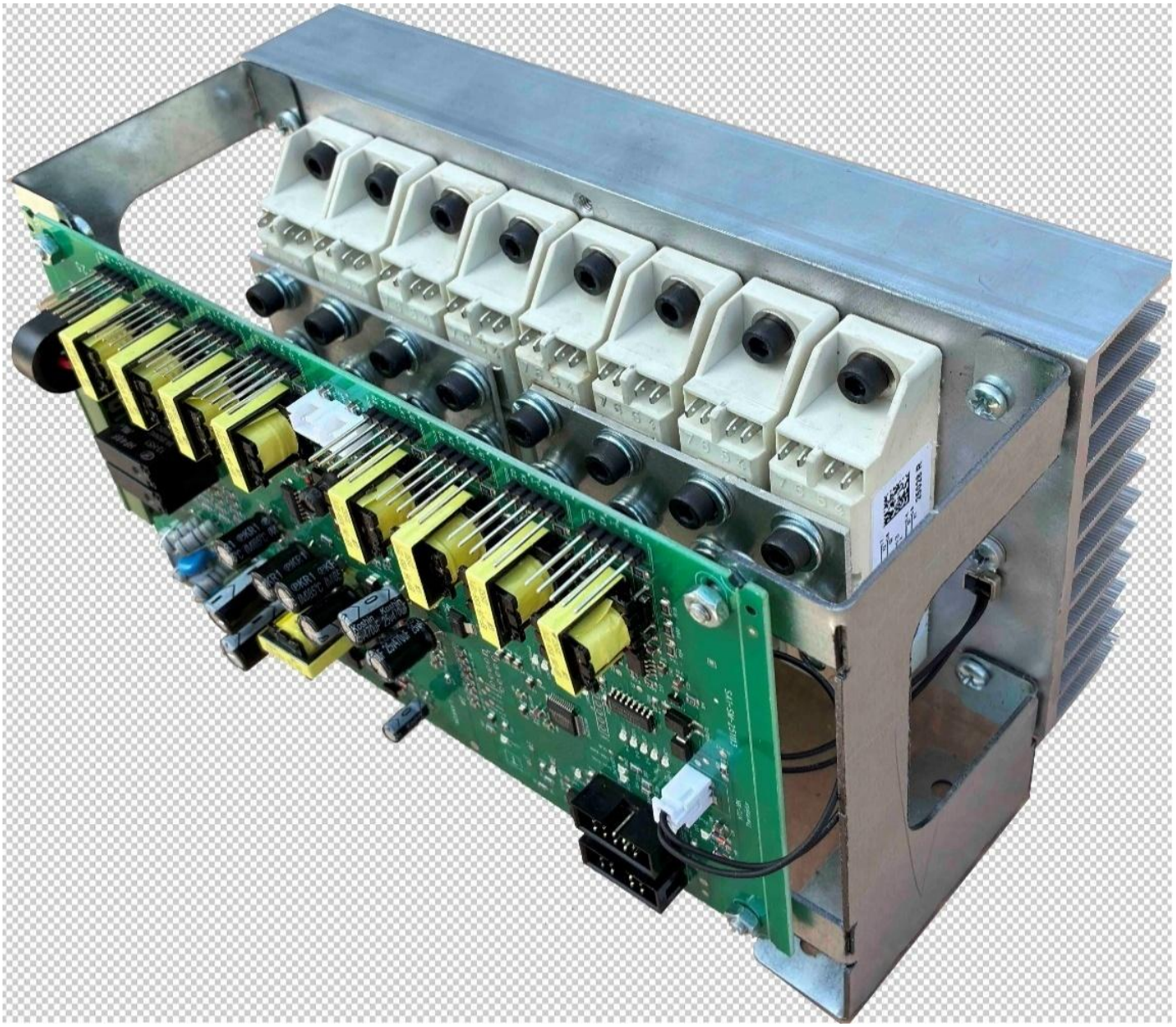

Figure 1 — General View of the SM-2603 Board

"Lankon" Engineering Group does not carry out the final assembly or manufacturing of any device. The Group only engineers and manufactures the embedded systems and electronic boards used in the final devices; it manages the processes of monitoring and controlling the devices over the internet and automatically sending any resulting error codes to the relevant e-mail addresses. It also provides consultancy services to manufacturing companies on the use of these devices.

The names of the relevant user manuals for using the SM-2603P power section in the static voltage regulator are as follows:

1. SM-2603, main board.
2. SM-2603P power section.
3. EPM-310 display.

You can download the current user manuals from the following internet sources.

https://gearsteady.com/documents

https://github.com/Sabir392/devices

Date: 2026/07/05

SM-2603P User Manual

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2. Safety Warnings

The following warnings must be strictly observed for the device to be used safely and correctly:

🔴 When powering the board, do not forget that it carries an electrical voltage that is dangerous to life.

🔴 If, during connection, one board's UART-0 input is connected to another board's UART-0 input, or if the phase and neutral lines between boards are reversed, the boards and thyristor modules may suffer irreversible damage once power is applied to the board.

⚠️ It is mandatory to use a 0.1 µF…1 µF AC capacitor between terminals A1 and A2 of the contactor coil.

⚠️ Grounding the enclosure is mandatory for the safe operation of the device; never operate the device without grounding it. Lack of grounding creates a risk of electric shock.

⚠️ Before operating the system at maximum capacity, be sure to complete the thermal and electrical calculations.

3. About the “SM-2603P” unit.

“SM-2603P” is not manufactured by the company as a separate product. This name has been given to the user manual that describes the procedure for preparing, assembling, and adjusting the power section used together with the “SM-2603” main board in the static voltage regulator.

4. What Do You Need?

If the single-phase device draws a continuous current of 106 amps from the input, the materials required for the single-phase power section are:

4.1. 'SM-2603' thyristor driver main board ..... 1 pc
4.2. '760 AS' Aluminum Heatsink 230 mm, 35mm, 110mm ..... 1 pc
4.3. Electronic board holder ..... 2 pcs
4.4. Heatsink fan holder ..... 1 pc
4.5. Aluminum busbar 80 x 32 x 2 mm ..... 2 pcs
4.6. Thyristor module 106 amps 1200V ..... 8 pcs
4.7. Thyristor module gate cable ..... 8 pcs
4.8. 6 µF 475V AC capacitor 2 pcs ..... 2 pcs
4.9. FAN 120x120x25mm 230 VAC 0.08 A ..... 1 pc

Figure 2 — **'760 AS' Aluminum Heatsink 230 mm, 35mm, 110mm**

Figure 2 shows the hole locations of the '760 AS' Aluminum Heatsink and the riser iron part. You can download the DXF file of these hole locations from the links given above.

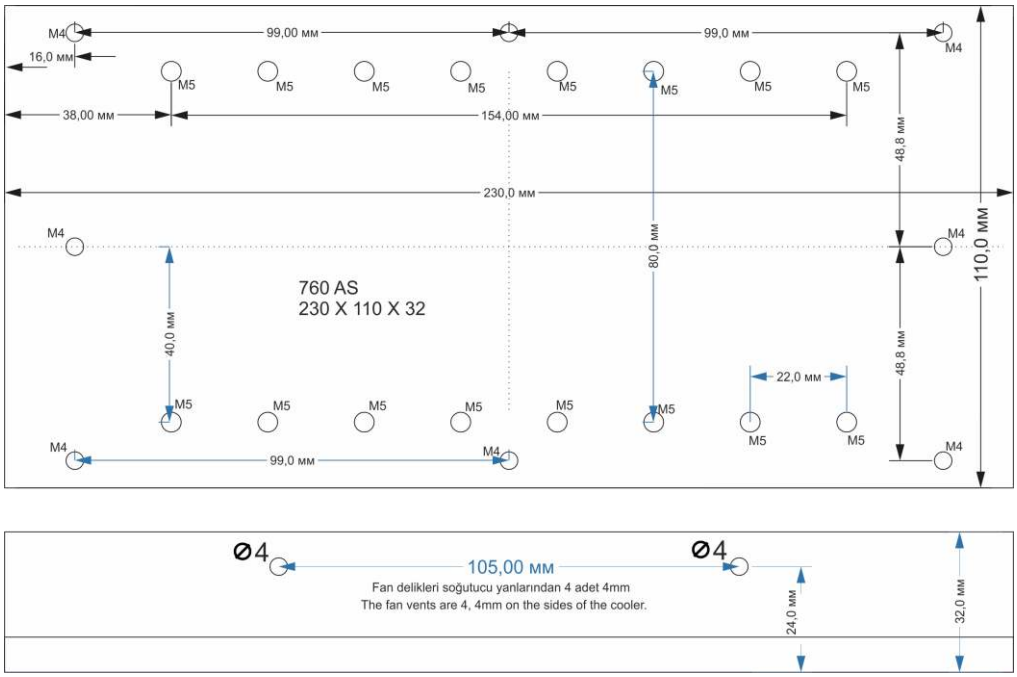
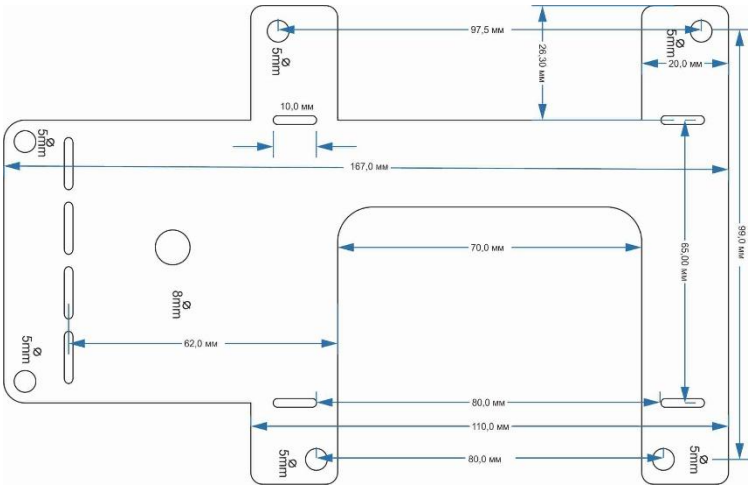


Figure — 3 **'SM-2603T' Electronic board holder**

Figure — 4

'SM-2603F' Heatsink fan holder



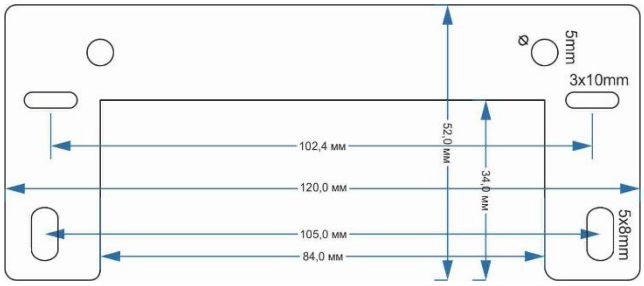


Figure — 5

'SM-2603B' Aluminum busbar

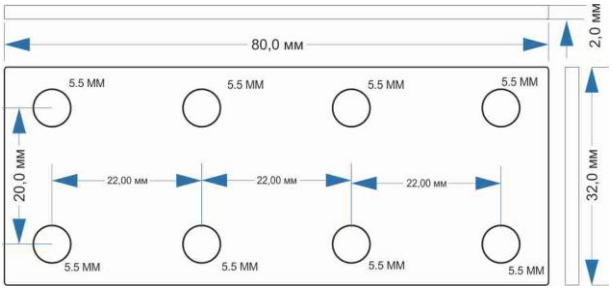


Figure — 6

Assembled thyristor group

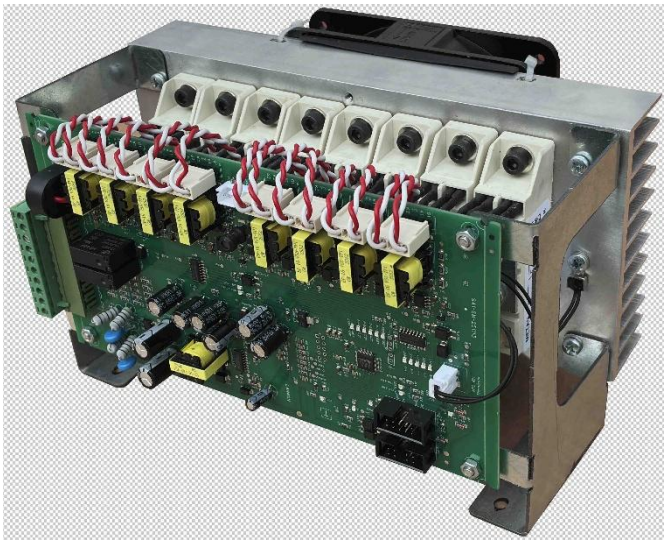


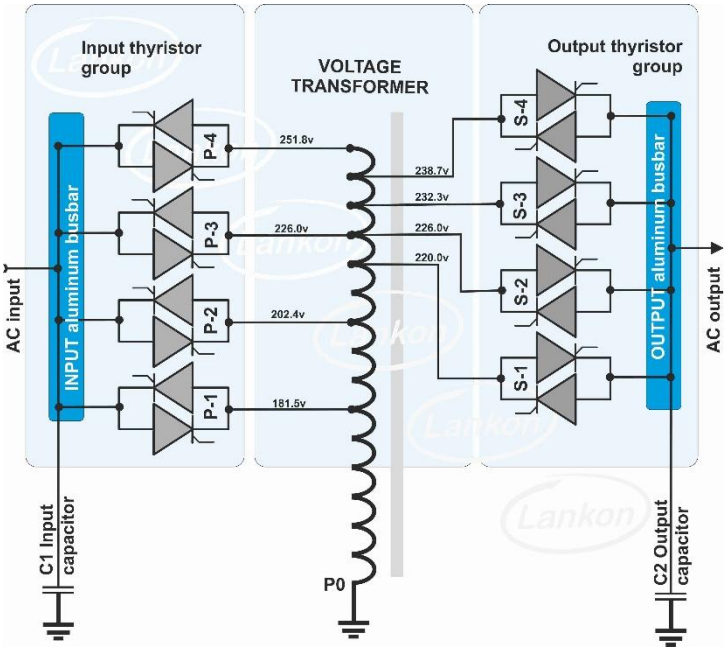
Figure — 7

Fully assembled thyristor group

5. Static Voltage Regulator Operating Principle.

The alternating current (AC) input to the device is applied to the **autotransformer**.
The primary and secondary windings of the autotransformer are electrically connected to each other. The secondary (output) voltage is taken from different connection points on the winding.
Each connection point (e.g., P-1, P-2, P-3, P-4) corresponds to a different number of turns, and this is how the **voltage conversion ratio** is determined.
Based on the input voltage continuously monitored by the microprocessor, the regulator selects the appropriate tap on both the input and output sides.
If the input voltage rises, the control circuit activates a higher-turn tap (e.g., P-4 → 251.8 V, with S-1 → 220.0 V at the output);

Figure 8 — Static Voltage Regulator Operating Principle Diagram



if the input voltage is low, a lower-turn tap (e.g., P-1 → 181.5 V, with S-4 → 220.0 V at the output) is selected.
In this way, the output is always kept stable around 220 V.

The **thyristor switch groups** that perform this operation are located on both sides, as seen in the figure:

- **Input Thyristor Group (P1-P4)** – Selects the appropriate winding tap of the autotransformer according to the mains voltage.
- **Output Thyristor Group (S1-S4)** – Transfers the selected voltage to the output busbar and provides a stable voltage to the load.

Both groups are connected via the **aluminum busbar** for high-current transmission.
The **C1 and C2 capacitors** at the input and output damp harmonics and transient noise, resulting in a cleaner waveform.

Visual Explanation (According to the Figure)

- **P1–P4**: Input thyristor stages (181.5 V → 251.8 V).
- **S1–S4**: Output thyristor stages (220 V → 238.7 V).

- **P0**: Common (neutral) terminal of the autotransformer.
- **C1, C2**: Input and output filter capacitors.
- **Busbar (aluminum bar)**: Transmission line carrying high current.

The microprocessor continuously compares the input and output voltages.
When the set limits are exceeded, the appropriate thyristor switch is automatically activated.
In this way, the regulator provides fast, silent, and highly accurate voltage stabilization entirely electronically, without any mechanical movement.

6. Auto Transformer Calculation

In the static voltage regulator, at least one power autotransformer is always used. This transformer is calculated according to the requirements of the voltage regulator.

The possible values in the requirement are as follows:

1) Maximum power to be loaded on the voltage regulator …….. 10 kVA
2) Minimum voltage to be corrected …… 170V
3) Desired output voltage ……. 220V
4) Maximum output voltage tolerance desired …… 5.4V
5) Number of thyristor modules …… 4 x 4 (8) pcs.

As can be seen, requirements 1, 2, and 3 are calculated in the standard way, the same as for other voltage regulators; the wire and core diameter are also the same. In the Static Voltage Regulator, more taps are taken from the autotransformer and thyristor modules are used according to the requirement.

The maximum voltage value to be corrected is derived automatically from values 2, 3, and 4.

The voltage values to be obtained from the transformer taps are automatically displayed on the screen by the microprocessor, in accordance with the entered values, via menus 9, 10, 11, and 12 of the “EPM-310” unit. For example.

As the service menu values are changed, the microprocessor displays the required calculation result on the screen online. Even though 3 x 3 (6) thyristor modules do not meet the requirement conditions, the number is forced to be recorded as 4 x 4 (8). The corresponding transformer calculations are shown on the LCD screen as in the picture.

1. Middle value of the desired output voltage. (220V)
2. Output voltage sensitivity. (5.4V)
3. Number of thyristor modules. (4 x 4, eight pcs.)
4. Transformer lower voltage. (167 — meaning the output voltage does not drop below 214.6V)
5. Automatic exit countdown from the menu. (If no keys are pressed, the exit countdown from the menu continues)
6. Output voltage sensitivity percentage. (2.4%)
7. Number of static stages.
8. Minimum voltage percentage to be corrected (23%)
9. Maximum voltage percentage to be corrected (15%)
10. Voltage at transformer secondary terminal 4 (245.9V)
11. Voltage at transformer secondary terminal 3 (240.0V)
12. Voltage at transformer secondary terminal 2 (234.2V)
13. Voltage at transformer secondary terminal 1 (228.6V)
14. Voltage at transformer primary terminal 1 (188.2V)
15. Voltage at transformer primary terminal 2 (207.4V)
16. Voltage at transformer primary terminal 3 (228.6V)
17. Voltage at transformer primary terminal 4 (251.9V)
18. Maximum voltage value to be corrected. (That is, if the input voltage is below 252, the output voltage cannot be higher than 225.4V)
19. Return-to-upper-menu indicator.
20. Number of the parameter currently being changed

    0 Parameter currently being changed

The procedure for navigating the menus is described in detail in the “EPM-310” user manual.

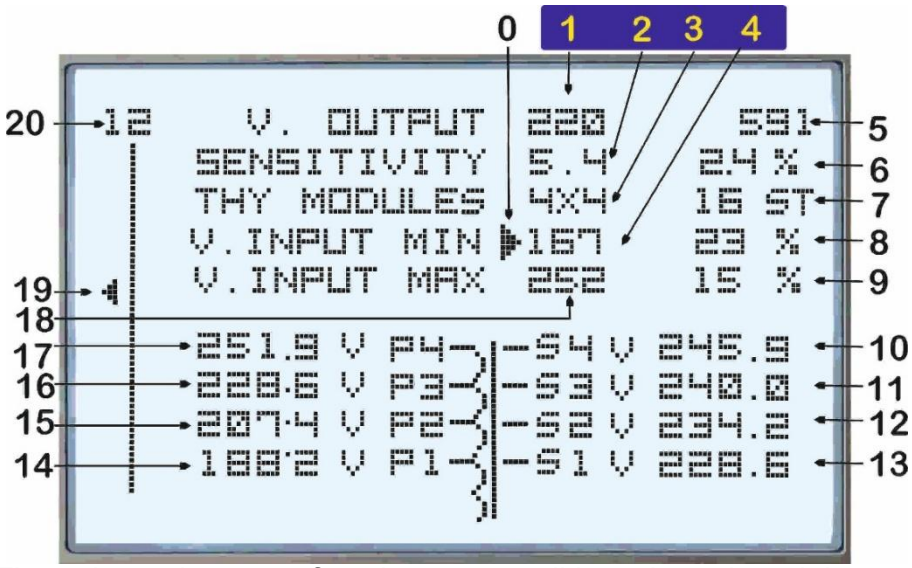


Figure 9 — EPM-310 Auto Transformer Calculation Screen

7. Structure of the Thyristor Module

Inside a thyristor module there are **2 thyristors**. These two thyristors are combined in a single housing, from which **7 pins** are brought out.
These pins are divided into two groups:
Standard connection pins (1, 2, 3): These have the same function across all brands and models. Their connection order and function do not change from manufacturer to manufacturer.
Trigger pins (4–5 and 6–7): Used to trigger each thyristor individually. The marking and numbering of these pins **vary from manufacturer to manufacturer.** This variation is a common situation in the industry and requires attention.

Triggering the First Thyristor
To trigger the first thyristor in the module, **pins 4–5** are generally used. However, the marking order may not always be "4–5"; some modules may have **reversed marking as "5–4"**. In different housings, these pins may also come out from other positions.
To prevent this confusion from causing damage, the thyristor drive sockets on the **SM-2603 driver board** are marked
"G1–K1".

✅ **Correct connection rule:**

- The pin marked **"G1"** on the module → **G1** pin on the driver board
- The pin marked **"K1"** on the module must be connected to the **K1** pin on the driver board.

⚠️ **Important:** in the connection, action should be taken based not on the pin number but on **the pin label (G1, K1)**.

Triggering the Second Thyristor
The trigger terminals of the second thyristor are generally **pins 6–7.** However, in some modules this marking may be **reversed, as "7–6"**.
In this case too, for correct connection, the sockets on the **SM-2603 driver board** are **marked "K2-G2"**.

✅ **Correct connection rule:**

- The pin marked **"K2"** on the module → **K2** pin on the driver board
- The pin marked **"G2"** on the module must be connected to the **G2** pin on the driver board.

⚠️ **Important:** here too, action should be taken based not on the pin number but on **the pin label (K2, G2)**.

🔴 **Critical Warning:** when making connections, action must be taken based not on **the pin numbers on the module but on the G1–K1 and K2–G2 labels**. In case of incorrect connection, the thyristor module and driver board **may suffer irreversible damage.**

8. Thyristor Module Integrity and Connection Test

⚠️ **Warning: It is not possible to test with 100% accuracy, using an ordinary measuring device, whether a thyristor module is faulty. The integrity of the desired thyristor module can only be easily determined by using the procedure described here.**

If all the markings on your thyristor module have been erased, **(G1–K1 and K2–G2)** pin labels must be identified.

Physical Structure of the Module

The gate driver pins of the thyristor module are always **4 thin pins (2+2)**. Separating these two gate groups is always **a raised barrier 3 mm wide**.

The other **3 power-carrying pins** are thick, and marked permanently and clearly on them are the numbers **3, 2, and 1**.

Step 1 — Insulation Resistance Check

Before connecting any cable to the thyristor module, use a measuring device to measure the resistance between each of pins **3, 2, and 1**. The resistance value between all these pins must be **greater than 1 MΩ**.

Step 2 — Identifying the Gate Pins

The **4 thin pins** that make up the gate group always emerge next to **power pin 3**.

Using the measuring device, measure the resistance between **pin 1** and **each of the 4 thin pins** one by one.

- **Pin 1** and **only one** of the thin pins — if a resistance of **0 Ω** is read between them, that pin's label is determined as **"K2"** and it is connected to the **"K2"** point on the board. The pin right next to it is then determined as **"G2"** and connected to the **"G2"** point on the board.
- **The thick pin 2** is always located exactly midway between the **power pins 3 and 1**. If, between one of the remaining thin pins and **pin 2**, a resistance of **0 Ω** is read, that pin is identified as **"K1"** and connected to the **"K1"** point on the board. The one remaining thin pin is then identified as **"G1"** and connected to the **"G1"** point on the board.

Step 3 — Preparing the Test Environment

The following equipment must be ready for the thyristor module integrity test and pin function identification:

- A non-conductive (insulated) test table
- **"SM-2603"** board
- **"EPM-310"** display board
- One flat cable **for communication between the boards**
- A measuring device (multimeter)

Step 4 — Connection and Voltage Application

1. **To the SM-2603** board's **UART-0** terminal, connect the flat cable coming from the **"EPM-310"** display board.
2. **To the SM-2603** board's **J3** terminal's **"Bypass"** and **"Neutral"** inputs, apply an AC voltage of **36V … 240V**. *(All other pins of the J3 terminal must be left unconnected. The red LED numbered 16 on the* **SM-2603** board, labeled 'BYPASS ERR', should light up, and the display should show 'BYPASS'*)*

Step 5 — Menu Settings

1. **On the EPM-310** graphic display, after switching to the **"PHASE(R)1"** page, press the **"SET"** button.
2. From the on-screen list, use the **"UST"** or **"ALT"** button to go to **menu 25** (**"SMPS/PCB SERVİS"** row), then press **"SET"** again.
3. The value in the menu that opens must be **64**. When you use the **"ALT"** button to lower it to **32**, the **"CUR ERR"**, **"TRM ERR"** and **"ERR+"** warning LEDs on the board will start blinking rapidly and continuously. The exit countdown value will lock at 950.

Step 6 — Thyristor Module Diode Test

1. Set the measuring device to the **diode measurement** position.
2. When the value in the menu is **16**, the **"P-4" "S-1"** LEDs will blink once per second.

- **When the LED is on:** the diode voltage between **pins 1-2** of the tested thyristor module must be between **0.3V … 0.8V**.
- **When the LED is off:** the measuring device should not show any value between these pins.

3. If the same values are also measured at the same time between **pins 1–3**, the thyristor module is **sound**, meaning the pins have been correctly identified and the gate cables correctly connected.

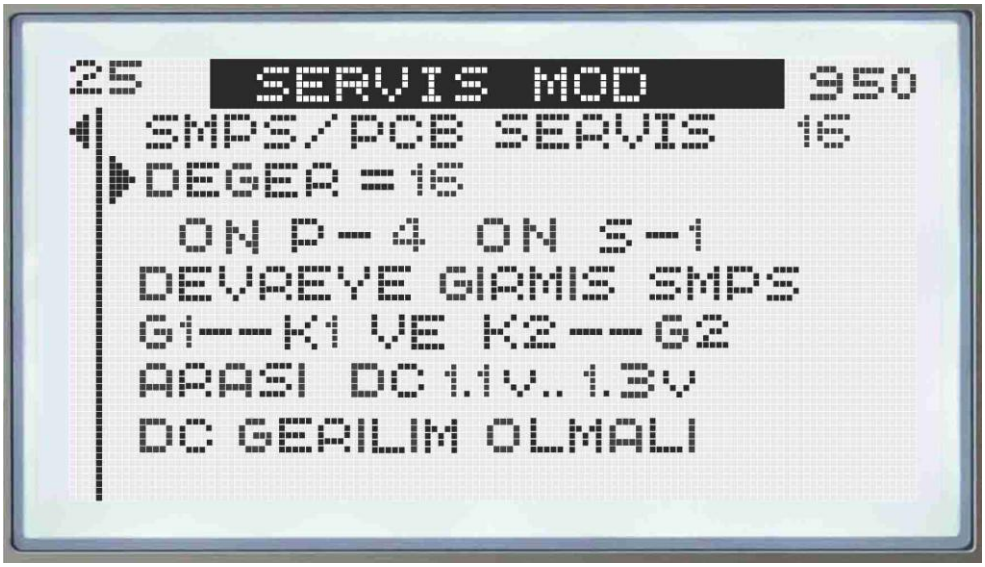
💡 **Note:** if you also want to test the integrity of the SMPS transformers on the PCB, **do not exit the menu.**

⚠️ **Quick Access Tip:** to quickly access the thyristor module integrity test, plug the gate pins of the thyristor module to be tested — without changing their order — into the **"P-4"** socket on the board.

9. SMPS/PCB Service

4. **The SMPS/PCB Service procedure continues from menu 25 in the 'Thyristor Module Integrity and Connection Test' section.**

Figure 10 — Faulty connection, menu row 26



This procedure may generally be needed during PCB manufacturing.
In order to test the accuracy of the commands sent to the thyristor module gates, the relevant outputs must be activated via the menu. As the value in the menu decreases from **17 to 1**, the corresponding **P-1 … P-4** and **S-1 … S-4** thyristor gate terminals become active in sequence.

When measurements are taken at the active gate terminals:
G1 – K1 must have a voltage of **1.2V DC**. K2 – G2 must also have a voltage of 1.2V DC.

⚠️ **Warning:** if the measured voltage value deviates by more than **20% from 1.2V**, it means there is a fault on the board and a technical inspection must be carried out.

10. Locating Incorrectly Connected Transformer Leads.

During manufacturing, incorrect connection of the leads coming out of the transformer to the thyristor modules is one of the most frequently encountered problems. This problem can sometimes cause the output voltage to fluctuate instead of remaining stable, and can sometimes cause the error codes “ERROR=164”, “ERROR=264”, or “ERROR=364” to be displayed on the screen depending on the faulty phase.
10.1. Before starting to resolve the problem, disconnect the system from voltage.
10.2. Connect the flat cable coming from the EPM-310 display board to the “UART0” terminal of the faulty phase.
10.3. Remove the cable going to “UART1” on the same board and leave it disconnected.
10.4. Apply voltage to the system.
10.5. After entering row 26, “TRAFO BAĞLANTI KONTROL”, in the service menu, the value 63 shown on the screen must be decreased using the “ALT” button. If the value drops below 59, the “ERR+” red LED on the **SM-2603** board starts blinking continuously.
When the value reaches exactly 31, the relay that activates the output contactor will close.
Primary thyristor module P-4 (4) and secondary thyristor module S-1 (1) will become active.
A “+” sign will be displayed in front of the number of the thyristor that has become active on the screen.

At this stage, the voltage value that should be present at pin 3 of each thyristor module will be displayed on the screen. Except for the active primary thyristor, the voltage values shown next to the other thyristor numbers are values estimated by the microprocessor, taking into account the current input voltage in accordance with the transformer calculation made from menus 9, 10, 11, and 12.

Figure 11 — Faulty connection, menu row 26, value 31

Different thyristor groups can be tested in sequence through this menu.
In addition, the “CUR-ERR” and “TRM-ERR” LEDs on the main board start blinking continuously.
From this point on, the values on the screen will be updated according to the value entered in the menu.

The number “949” will be permanently displayed in the top right corner of the screen in this menu.

11. IXYS and SEMIKRON Thyristor Module Gate Pins

Figure 12 — IXYS and SEMIKRON Thyristor Module Gate Pins

The picture shows the pin differences between two different thyristor modules that have the same housing.

As can be seen from the picture, there are differences between the modules both in numbering and in the function of the terminals. Therefore, if a SEMIKRON module is to be installed in place of an IXYS module, the positions of the gate cables must be swapped. In summary, as shown in the picture, after swapping the positions of cables

numbered 6 and 7, the cable going to the G-2 terminal of the main board must be connected to the G-2 pin of the module.

12. IXYS Thyristor Module Gate Cable Housing

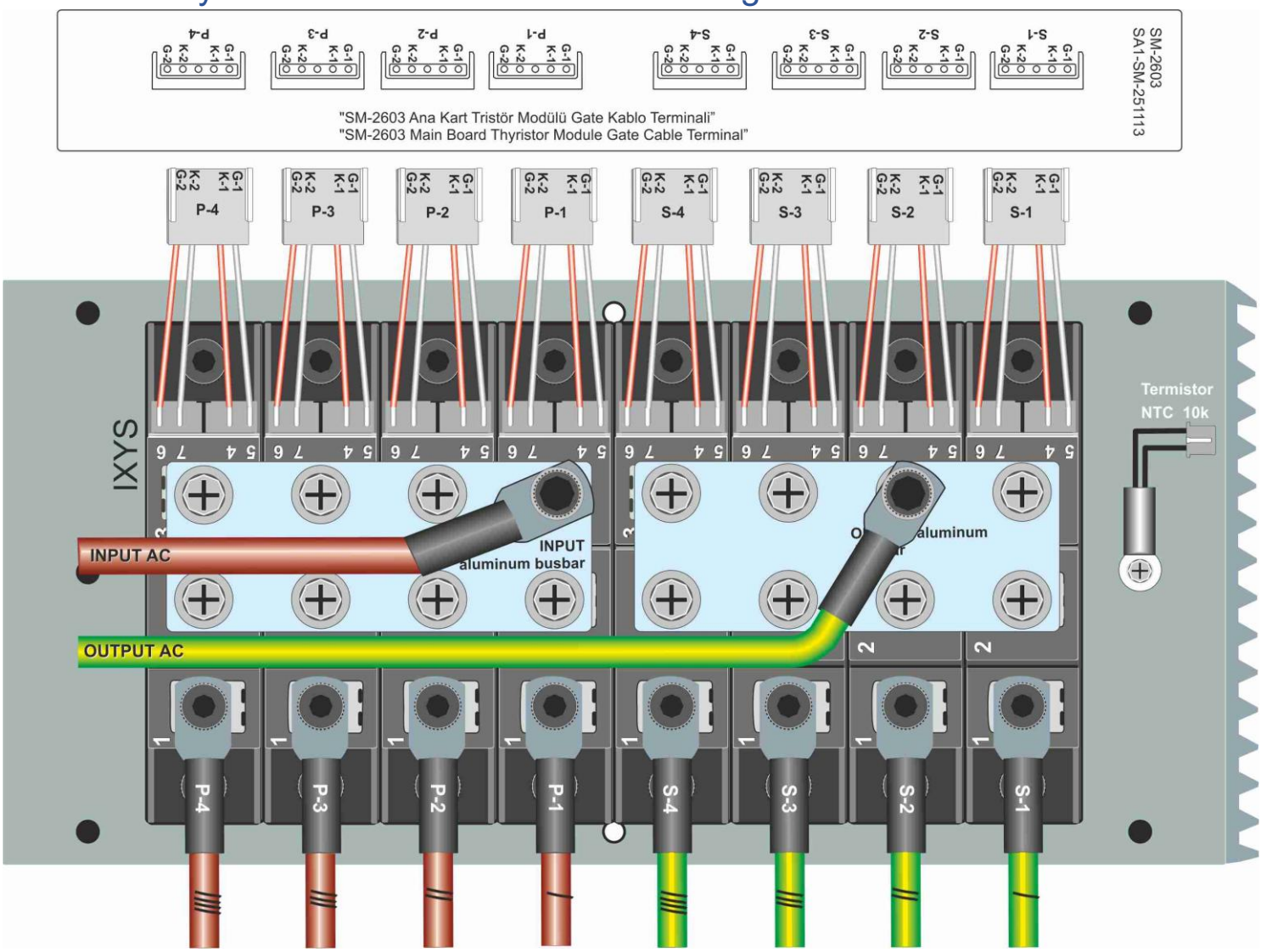


Figure 13 — SM-2603P power section assembled with IXYS modules.

13. Contact Information

	Lankon Engineering Group
Website 1	https://gearsteady.com/documents
Website 2	https://github.com/Sabir392/devices
E-mail 1	info@gearsteady.com

License	GPL v3 — https://www.gnu.org/licenses/gpl-3.0.html
Version	2026.03