EPM-310 Voltage Regulator Electrical Parameter Monitor

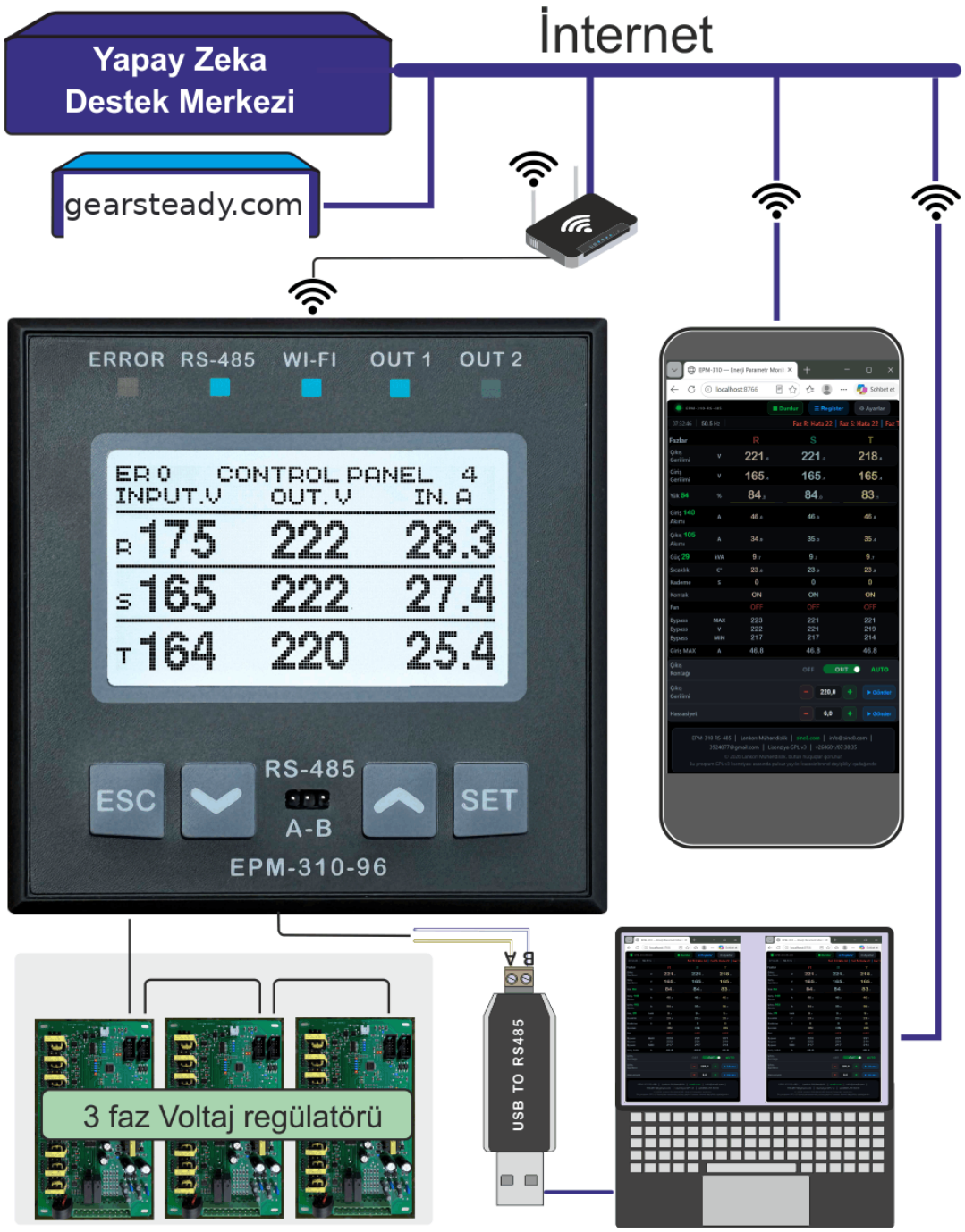

Fig. 1 Static voltage regulator EPM-310 General block diagram

The "Lankon" Engineering Group does not carry out the final assembly or manufacturing of any device. The Group only engineers and produces the embedded devices and electronic boards used in final devices, and provides consulting services on their use.

This user manual has been prepared to facilitate the servicing of the "LANKON SM-2603" main board used in the manufacturing of static voltage regulators, and is valid for models up to 3000 kVA power.

The latest related documents can always be downloaded from the links given below.

https://gearsteady.com/documents
https://github.com/Sabir392/devices

"SM-2603-en", "SM-2603P-en", "EPM-310-en", "EPM-310-RS-485-en" and "EPM-310-Wi-Fi-en" user manuals must be read carefully to use the board.
When powering the boards, do not forget that they carry electrical voltage that is dangerous to life.

EPM-310 USER MANUAL

Date: 2026/07/05

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1. Safety Warnings

WARNING - Do not put the device into operation without reading this section.

⚠ **Safety Warnings — Please Read First**

The EPM-310 is installed inside voltage regulators operating on mains voltage (90 V / 460 V AC). Installation and maintenance work must only be carried out by authorized and qualified electrical personnel.
Do not remove / insert the flat cable or any connector while the device is energized. Never disable the two blocked pins at one end of the flat cable.

STRICTLY PROHIBITED ACTIONS

- **Do not remove / insert the flat cable or any connector while the device is energized.**
- **The secondary circuit of a loaded CT (current transformer) must never be left open — this creates high voltage and can be fatal.**
- Do not cover the device — this restricts cooling and creates a risk of overheating.
- Do not allow persons without technical knowledge to change the service menu parameters.
- The device draws its DC supply from the flat cable. Supplying power from an external source is strictly forbidden.

REQUIRED BEFORE INSTALLATION

- Before installation, disconnect all input power of the voltage regulator and open the fuses.
- Make sure the capacitors are fully discharged (wait at least 3 minutes).
- Verify that all boards are de-energized before making the flat cable connection.
- Pay attention to A/B polarity when connecting the RS-485 line — reversed connection prevents communication.
- Check the panel cutout dimension (92 × 92 mm) before mounting the device in place.

2. Definition of the Device Name

The device name Lankon EPM-310 is made up of the abbreviation of the components specified below.

Component	Description
Lankon	The proper name of the engineering team that developed the device.
E	Electrical
P	Parameter
M	Monitor
3	Three-phase system
10	Project number 10

3. Purpose of the Device

The EPM-310 is an embedded display and monitoring board designed for use in the manufacturing of voltage regulators.
- Communicates via UART with the driver boards for each phase of the voltage regulator and displays the data on the screen.
- Provides access to all operating parameters without opening the regulator chassis.
- Transmits data directly to the internet without requiring an additional modem.
- Allows remote parameter changes and output contactor control via Wi-Fi.
- Integrates with SCADA/BMS systems via the RS-485 Modbus RTU protocol.
- Transmits fault codes to external systems via the Wi-Fi and RS-485 interfaces for Artificial Intelligence (AI) reporting systems.

4. Technical Specifications

Feature	Value
Microcontroller	Nuvoton NuMicro series, 48 MHz HIRC
Display	128 x 64 pixel monochrome
Phase support	Single-phase (MONO) or 3-phase (automatic detection)
Main board communication	UART1 - flat cable, 38400 baud
Wi-Fi communication	UART2 - Wi-Fi module, 115200 baud
RS-485 Modbus RTU	UART0, isolated port, 9600/19200/38400 baud
Number of monitored data points	246 in total from 3 phases, 13 display pages
Data update rate	0.02 seconds (from all boards)
Frequency measurement	Hardware counter, 48...85 Hz
Number of buttons	4: ESC, DOWN, UP, SET
Number of LEDs	5: ERROR (red), RS-485, Wi-Fi, OUT1, OUT2 (blue)
Software version	35

5. Structure and Operating Principle of the Device

The EPM-310 is an embedded system with display and monitoring features used in the manufacturing of voltage regulators. It communicates with the display via the SPI interface, and with the “SM-2603” Static Voltage Regulator main boards via the UART1 interface (38400 baud, flat cable). It can also transmit data to remote systems via the Wi-Fi and RS-485 Modbus RTU interfaces.

5.1. Communication Architecture

The EPM-310 communicates with both local and remote systems through different interfaces:
- Display connection: SPI interface (u8g library, 128×64 monochrome)
- Main board communication: UART1, 38400 baud, via flat cable with “SM-2603” Static Voltage Regulator boards
- Wi-Fi: UART2, 115200 baud, internet connection via external Wi-Fi module
- RS-485: UART0, isolated port, SCADA/BMS systems via Modbus RTU protocol

Connection	Protocol / Speed	Description
Main boards <-> EPM-310	UART1, 38400 baud	Flat cable, power + data on a single line
EPM-310 <-> Wi-Fi module	UART2, 115200 baud	Browser-based remote access
EPM-310 <-> SCADA/BMS	RS-485 Modbus RTU	Isolated port, 2 lines on the front panel

5.2. Automatic Phase Detection

Based on information from the connected driver boards, the device automatically identifies the system as Single-Phase or 3-Phase. In single-phase systems, all display pages show mono-phase data.

5.3. Related User Manuals

To work at full efficiency with the EPM-310 system, it is recommended to also review the following user manuals:
1. SM-2603 — Static Voltage Regulator driver board user manual
2. EPM-310-RS-485 — RS-485 Modbus RTU interface and PC software user manual
3. EPM-310-Wi-Fi — Wi-Fi module configuration and remote monitoring user manual

6. LED Indicators

There are 5 LEDs on the EPM-310.

LED Label	Color	Lighting State	Meaning
ERROR	Red	Blinks (0.5 s)	There is an active fault in the system

RS-485	Blue	Lit steady	RS-485 Modbus active
Wi-Fi	Blue	Lit steady	Wi-Fi connection active (Menu 29=1)
OUT1	Blue	Lit steady	Output contactor closed (load is powered)
OUT2	Blue	Brief blink	Modbus write operation received

7. Button Functions

Button	Normal Mode	Service Menu Mode	Special Function
ESC	Show fault detail if present (hold)	Return to upper menu / exit menu	ER=39: ESC+SET at the same time -> activates output
DOWN	Go to the previous display page	Decrease parameter value	To decrease the bar in log reset
UP	Go to the next display page	Increase parameter value	-
SET	Enter service menu (while on page 1-6)	Edit / confirm selected parameter	SET does not enter the menu on pages 7-13

NOTE: The service menu cannot be entered from pages 7 through 13. / These pages are for data monitoring only.

8. Display Pages

The device has 13 main monitoring pages. Navigation between pages is done with the DOWN and UP buttons. In single-phase systems, some pages are automatically skipped.

Page	Title	Content
1	Phase (R)1 - Advanced values	Output V, Input V, Current, Temperature, Load%, Step, Max/Min recorded values
2	Phase (S)2 - Advanced values	Same structure, data for phase S
3	Phase (T)3 - Advanced values	Same structure, data for phase T
4	3-Phase - Voltage + Input current	Input V and input current (IN.A) for phases R/S/T
5	3-Phase - Voltage + Output current	Output V and output current (OUT.A) for phases R/S/T
6	3-Phase - Voltage + Load percentage	Output V and load % (LOAD) for phases R/S/T
7	Quick analog + Indexed data	8 values each under PH_1/PH_2/PH_3 + 216 indexed log entries
8	Phase (R)1 - Log index 0-36	37 recorded values from the main board
9	Phase (R)1 - Log index 37-72	36 recorded values from the main board
10	Phase (S)2 - Log index 0-36	Phase S recorded values
11	Phase (S)2 - Log index 37-72	Phase S recorded values
12	Phase (T)3 - Log index 0-36	Phase T recorded values
13	Phase (T)3 - Log index 37-72	Phase T recorded values

8.1. Page 1-3 View — Single-Phase / 3-Phase Advanced Values

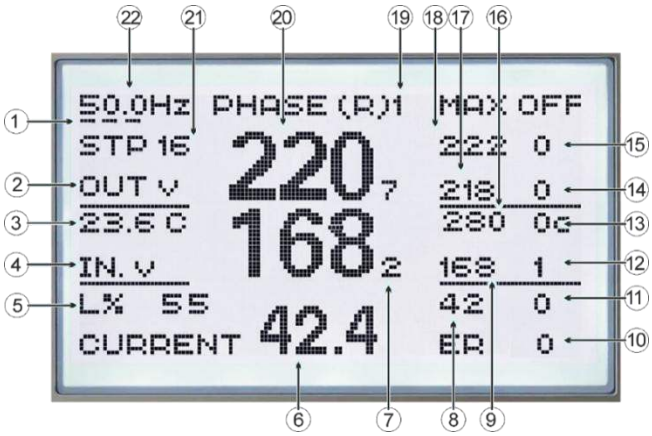
Pages 1, 2, and 3 display advanced values for each phase. In single-phase systems, the page title is shown as MONO PHA.

Fig. 2

Static voltage regulator

'Single-Phase / 3-Phase

Advanced Values'



No	Figure 2 — Single-Phase View Description	Notes
1	The device is connected after a generator. There are broken lines.	The connection order is not correct.
2	Output voltage.	"Bypass" will be shown here when in bypass mode
3	TEMPERATURE of the power section (THYRISTOR TEMPERATURE) 23.6 °C	When "C M" is shown, the device displays the highest recorded temperature value.
4	Current input voltage.	
5	Load percentage 55%, shown as "L".	If this value is decreasing by 1 per second, the device has put both itself and the loads under timed protection. When the countdown reaches 0, the system engages.

6	Input current 42.4 amps	
7	Current input voltage 168.6 V	
8	The highest current that has passed through and been recorded by the device. 42 A	
9	The lowest input voltage recorded after the output contactor engages.	
10	Fault number. (If there is a fault, pressing "ESC" shows the detailed screen)	If there is no fault, "ESC" clears the records.
11	Number of shutdowns recorded due to high current, 0.	
12	Number of times protection was exited after voltage was last applied to the device: 1.	The limit is set from Menu 14.
13	Number of times protection was entered due to insufficient cooling, 0.	
14	Number of output shutdowns due to low voltage, 0.	
15	Number of output shutdowns due to high voltage, 0.	
16	The highest input voltage recorded after the output contactor engages, 280 V	
17	The lowest output voltage recorded, 218 V	MIN
18	The highest output voltage recorded, 222 V	MAX
19	Phase (R)1, Phase (S)2, and Phase (T)3 marking when on page 1.	
20	Current output voltage 222.7 V	
21	The currently active static step.	
22	Frequency 50.0 Hz.	

8.2. Page 4-6 View — 3-Phase Summary

Pages 4, 5, and 6 show all three phases together. If the system has been shut down remotely, "REMOTE OFF" is displayed in the OUT.V field.

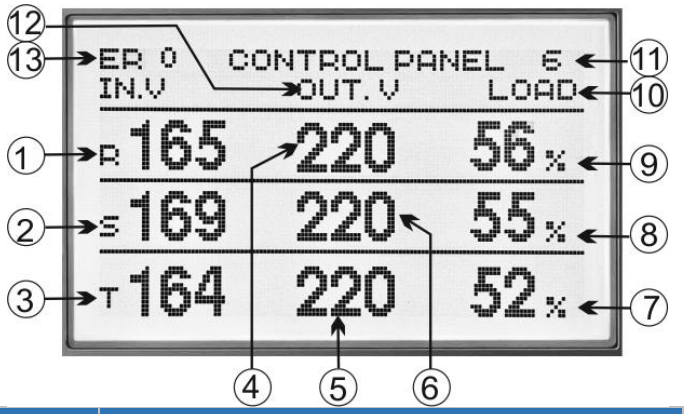


Fig. 3

Page 4-6

Display View

No	Figure 3 — 3-Phase Display View Description	Notes
1	Current input voltage, Phase (R)1 165 V	
2	Current input voltage, Phase (S)2 169 V	
3	Current input voltage, Phase (T)3 164 V	
4	Current output voltage, Phase (R)1 220 V	
5	Current output voltage, Phase (S)2 220 V	
6	Current output voltage, Phase (T)3 220 V	

7	Current load percentage, Phase (T)3 52%. (On display page 4 this location shows input current, on page 5 it shows output current)	3 different values are shown in the same place
8	Current load percentage, Phase (S)2 55%. (On display page 4 this location shows input current, on page 5 it shows output current)	3 different values are shown in the same place
9	Current load percentage, Phase (R)1 56%. (On display page 4 this location shows input current, on page 5 it shows output current)	3 different values are shown in the same place
10	If the active display is page 4 this will be the IN.A column, page 5 the OUT.A column, page 6 the 'LOAD' column values	3 different column names are shown in the same place
11	Active display page number. Currently page 6	
12	If the output contact has been switched off remotely, 'REMOTE OFF' will be shown here — from your server account, via RS-485, or via the AI application.	
13	Fault number. (If there is a fault, pressing "ESC" shows the detailed screen)	

8.3. Page 7 — Quick Data

Page 7 displays instantaneous raw data coming from the main boards. Since the data changes very quickly, it may not be clearly readable; this is normal.

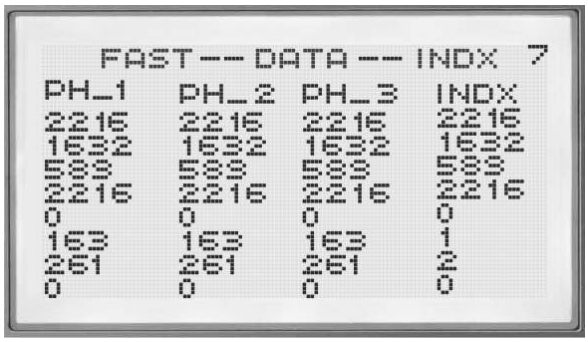


Fig. 4

Page 7

Display View

8.4. Page 8-13 — Log Values

Pages 8-13 display the logged data for each phase. Each page contains 9 values in 4 columns.

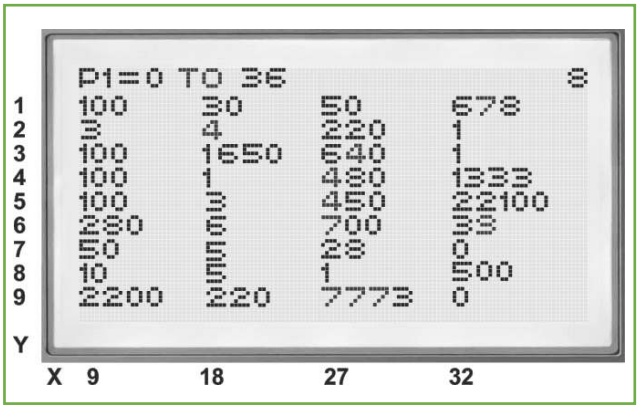


Fig. 5

Page 8-13

Display View

9. Error Codes

When a fault occurs in the system, ER=XXX appears on the display. At the moment of the fault, a more detailed description can be read by holding down the ESC button.

9.1. Error Code Format

System	Format	Example
Single-phase	2 digits: ER=XX	ER=32
3-phase - Phase R	3 digits: ER=1XX	ER=132
3-phase - Phase S	3 digits: ER=2XX	ER=232
3-phase - Phase T	3 digits: ER=3XX	ER=332

9.2. Error Code Table

Code	Description (Turkish)	Description (English)
1-4	Primer tiristör hata oluşturdu (P-1...P-4)	Primary thyristor caused a fault

5	Primer tiristör hatası (STEPS değerine göre pozisyon belirlenir)	Primary thyristor fault by STEPS
6-9	Sekonder tiristör hata oluşturdu	Secondary thyristor fault
10	Sekonder tiristör hatası - S-1/S-2/S-3/S-4 olarak belirtilir	Secondary thyristor fault - S-1/S-2/S-3/S-4
14	Isı sensöründen veri alınamadı	No data from temperature sensor
15	Sistem aşırı ısınmış / soğutma yetersiz	System overheated or cooling insufficient
17	Çıkış kontrol noktasında gerilim düşük	Output control voltage below expected
18	Giriş gerilimi kontrol noktasında düşük	Input voltage below expected value
19	Çıkış gerilimi kontrol noktasında yüksek	Output voltage above required value
20	Tiristör öncesi çıkışta gerilim var	Voltage at output before thyristor activation
21	Kontaktör öncesi bypass ucunda gerilim var	Voltage at bypass before contactor activation
22	Kontaktor oncesi cikis ve bypass'ta gerilim var	Voltage at output and bypass before contactor
23	Kontaktör öncesi bypass kontrol ucunda gerilim var	Voltage at bypass control terminal
24	Çıkış kontrol noktasında gerilim çok düşük	Output control voltage too low
25	Çıkış kontrol noktasında gerilim çok yüksek	Output control voltage too high
26	Bypass ve çıkış kontrol gerilimi aynı değil	Bypass and output control voltage not same
27	Booster trafo çıkış gerilimi düşük	Booster transformer output voltage too low
28	Yüksek frekans koruma devreye girdi	High frequency protection triggered
29	Düşük frekans koruma devreye girdi	Low frequency protection triggered
31	Boşta çalışma akımı yüksek	Idle current over limit
32	Yüksek akım - koruma limiti aşıldı	Current too high - limit exceeded
33	Akım crest faktörü x3 limitini aştı	Current crest factor x3 limit exceeded
34	Akım amplitüdü ölçülemez kadar yüksek	Current amplitude too high to measure
35	Nötr giriş - gerilim ölçümü için uygun değil	Neutral input not suitable for measurement
36	Nötr çıkış - gerilim ölçümü için uygun değil	Neutral output not suitable for measurement
37	Nötr bypass - gerilim ölçümü için uygun değil	Neutral bypass not suitable for measurement
39	Tekrar devreye gerilim verme limiti aşıldı (Menü No.14)	Reconnection voltage limit exceeded (Menu No.14)
42	Cihaz 3 faz ayarlı - Faz 2'den RS-232 verisi yok	3-phase set - no RS-232 data from Phase 2
43	Cihaz 3 faz ayarlı - Faz 3'den RS-232 verisi yok	3-phase set - no RS-232 data from Phase 3

10. Service Menu

10.1. Entering the Menu

The service menu can only be entered from Pages 1-6.
If entered from Page 1, the values for Phase (R)1 are affected; if from Page 2, Phase (S)2; and if from Page 3, Phase (T)3. If the menu is entered from other pages, all 3 phase values are affected at the same time. Press the 'SET' button briefly to activate the menu, opening a single-column menu page with 40 lines. Use the 'DOWN'/'UP' buttons to move the triangular arrow mark onto the parameter you want to change. Then press 'SET'. If the triangular arrow mark on the opened menu does not blink, press 'SET' again. Then change the value to the required value using the down/up buttons. Press 'ESC' to go back to the upper menu. When you return to the topmost menu, the changes made will be automatically saved. While the service menu is active, a countdown timer is active in the top right corner of the screen. When the counter reaches 0, the system automatically saves the values, exits the service menu, and returns to the main screen.

The explanation of the example screen, Figure 6, is as follows.

In the top left corner, '2' shows the line number of the triangular arrow mark that is scrolled with 'DOWN'-'UP'.

After the scrolled triangular arrow mark falls 8 lines behind, lines 9…16 will be displayed on the screen.

In the top right corner, '937' is the countdown timer that will exit the menu.
The Parameter Table is explained in more detail in the table below.

Fig. 6

Service menu bar

10.2. Parameter Table

Menu Page 1 — Parameters 1-8

No	Name	Range	Default	Description
1	Display Language	1-2	1 (TR)	1=Turkish, 2=English
2	Number of Phases	1 or 3	1	1=Single-phase, 3=Three-phase
3	Current Transformer (R) / 5A	5-5000	100	Primary current of the R-phase current transformer (A)
4	Current Transformer (S) / 5A	5-5000	100	Primary current of the S-phase current transformer (A)
5	Current Transformer (T) / 5A	5-5000	100	Primary current of the T-phase current transformer (A)
6	Current Protection Value	1-5000	280	Overcurrent protection threshold
7	Asymmetric Current %	20-100	50	Phase imbalance protection percentage
8	Current Protection Delay	1-999 s	10 s	Wait time before protection

Menu Page 2 — Parameters 9-16

No	Name	Range	Default	Description
9	Output Voltage	90-250 V	220 V	Target output voltage
10	Sensitivity (Tolerance)	0.1-30 V	5 V	Accepted voltage deviation range
11	Number of Thyristor Modules	4 (fixed)	4	Fixed at 4 modules in this version
12	Transformer Min. Input V	70-300 V	165 V	Minimum input voltage of the transformer
13	Power Transformer Type	1-2	1	1=Auto transformer, 2=Booster transformer
14	Number of Restarts	1-99	5	Max. automatic restarts after protection
15	Restart Delay	1-999 s	10 s	Wait time before each restart
16	Output Turn-On Delay	1-9999 s	5 s	Output wait time on first engagement

Menu Page 3 — Parameters 17-24

No	Name	Range	Default	Description
17	Output Turn-Off Delay	1-999 s	5 s	Delay before turning off the output after protection
18	Overvoltage Protection	---	220 V	Output is cut off above this value
19	Overvoltage Protection Delay	0.1-9.9 s	5.0 s	Delay of the overvoltage protection
20	Undervoltage Protection	---	220 V	Output is cut off below this value
21	High Frequency Protection	51-85 Hz	64 Hz	Engages if frequency exceeds this value
22	Low Frequency Protection	43-84 Hz	48 Hz	Engages if frequency drops below this value
23	Fan Start Temperature	max 65 C	45 C	Threshold at which the cooling fan engages
24	Overheat Protection	45-90 C	70 C	Output is turned off at this temperature

Menu Page 4 — Parameters 25-32

No	Name	Range	Default	Description
25	SMPS/PCB Service	16-64	64	Thyristor gate test - authorized service only
26	Transformer Connection Service	16-63	63	Shows transformer tap point voltages
27	Menu Password	1-9999	7773	Password for entering the service menu
28	Wi-Fi Password	1-9999	6789	Last 4 digits of the Wi-Fi network
29	Wi-Fi On/Off	0-1	1 (On)	0=Off, 1=On
30	Network Parameter	---	---	Reserved
31	Remote Shutdown	1333/1444	1333	1333=Auto (On), 1444=Off
32	Reserved	---	---	Reserved

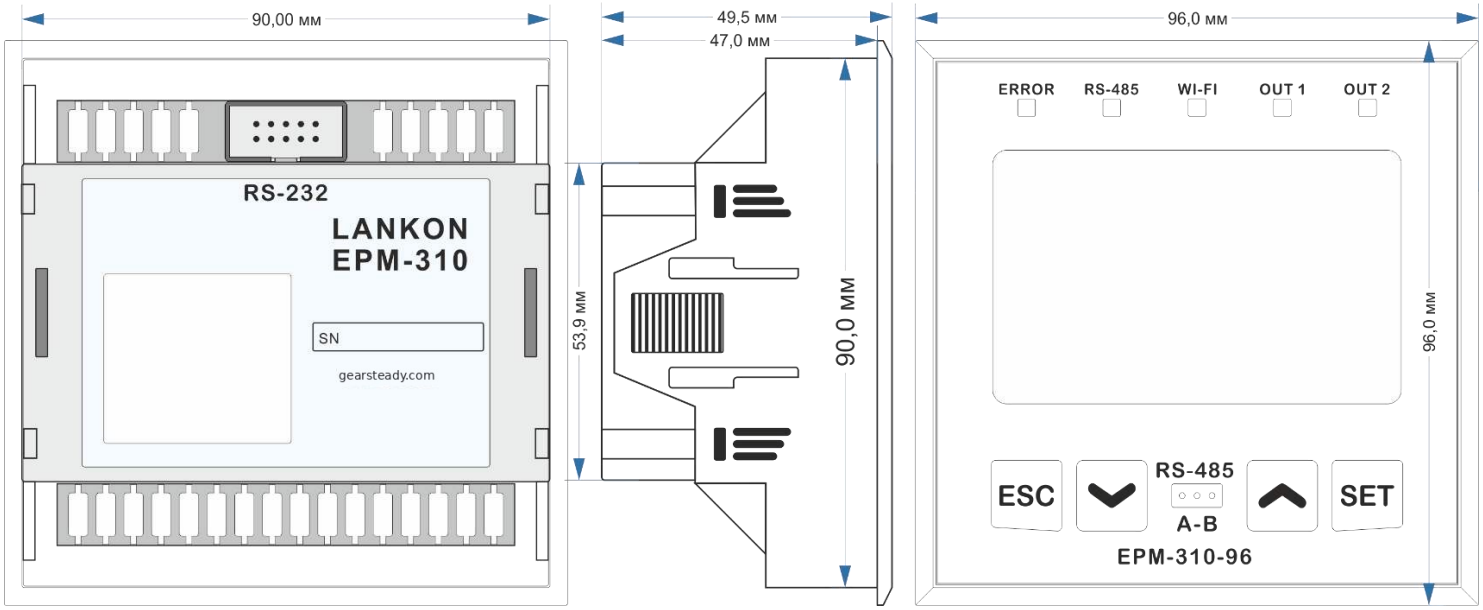
Menu Page 5 — Parameters 33-40

No	Name	Range	Default	Description
33	RS-485 On/Off	0-1	1 (On)	0=Off, 1=On
34	RS-485 Device ID	1-244	1	Modbus slave address
35	RS-485 Baud Rate	1-3	3 (38400)	1=9600, 2=19200, 3=38400 bps
36	RS-485 Data Bits	8 or 9	9	8 or 9 data bits
37	RS-485 Stop Bit	0 or 1	1	Number of stop bits
38	Reserved 4	---	---	Reserved
39	Reserved 5	---	---	Reserved
40	Reserved 6	---	---	Reserved

16. Dimensions

See the drawing below for the physical dimensions and mounting information of the EPM-310.

Fig. 9 — Dimensions.



17. Contact

Information	Detail
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