# Sigma Engineering.

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## Installation &Operation Manual

**Three phase voltage stabilizer**

**Sigma Turbo Stabilizer Series**

**STS 33 Series**

**10- 30 – 45 – 60 – 75-100 – 150**
**175 - 200 -300- 400 – 500-1000-1500 KVA**


We take care of your loads.

SIGMA

**Dear customer,**

We thank you for choosing our products.

We trust that use of the servo stabilizer will give you complete satisfaction.

## Contents

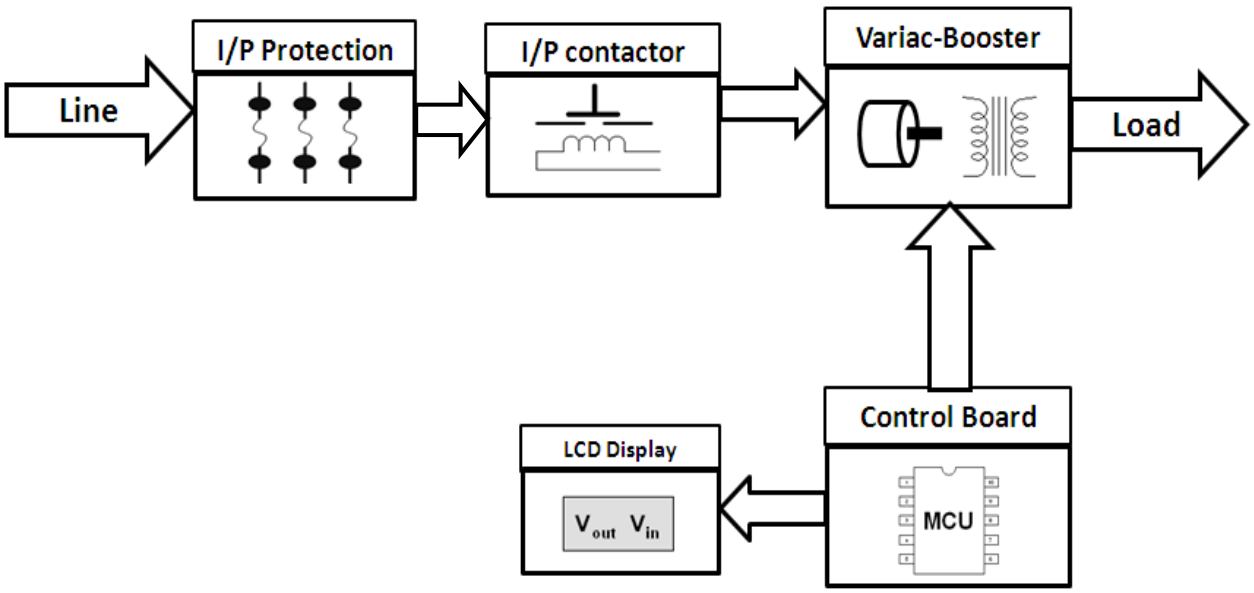
# 1. Introduction

## 1.1. General description.

**TURBO Series of Three Phase Servo Stabilizers are an electrical regulator designed to automatically maintain a constant voltage level and reliable performance with their outstanding features and design.**
**It uses a separate control per phase and providing the easiest user interface.**

## 1.2. System block diagram.

**The servo voltage stabilizer mainly composed from input line fuses *(input protection)*, input contactors, variacs, boosters, control unit and display unit.**




## 1.3. General specifications.

- **Micro Controlled System.**
- **Input/output true RMS measurements.**
- **Programmable overload, over & lower output voltage protection.**
- **Load Level, Output Voltage, Input Voltage LCD Display.**
- **Wide L-L correction range operation (-25%, +25%) 285 – 475 VAC .**
- **Programmable nominal output Voltage 210:230.**
- **High input voltage protection.**
- **90 Volts/sec Dynamic Regulation Speed.**
- **0.5% Static Regulation.**

# 2. Operation

## 2.1. Principle of operation.

**Turbo servo stabilizer is based on micro-controller unit (MCU) [*microchip and ARM technology*]. The target of the stabilizer is providing stable voltage and overload protection.**

**By measuring the input and output voltage, when the input voltage or load changes, the control unit will initiate the correction process and it occurs when the output voltage is out of range [±0.5% to 3% of nominal value].**

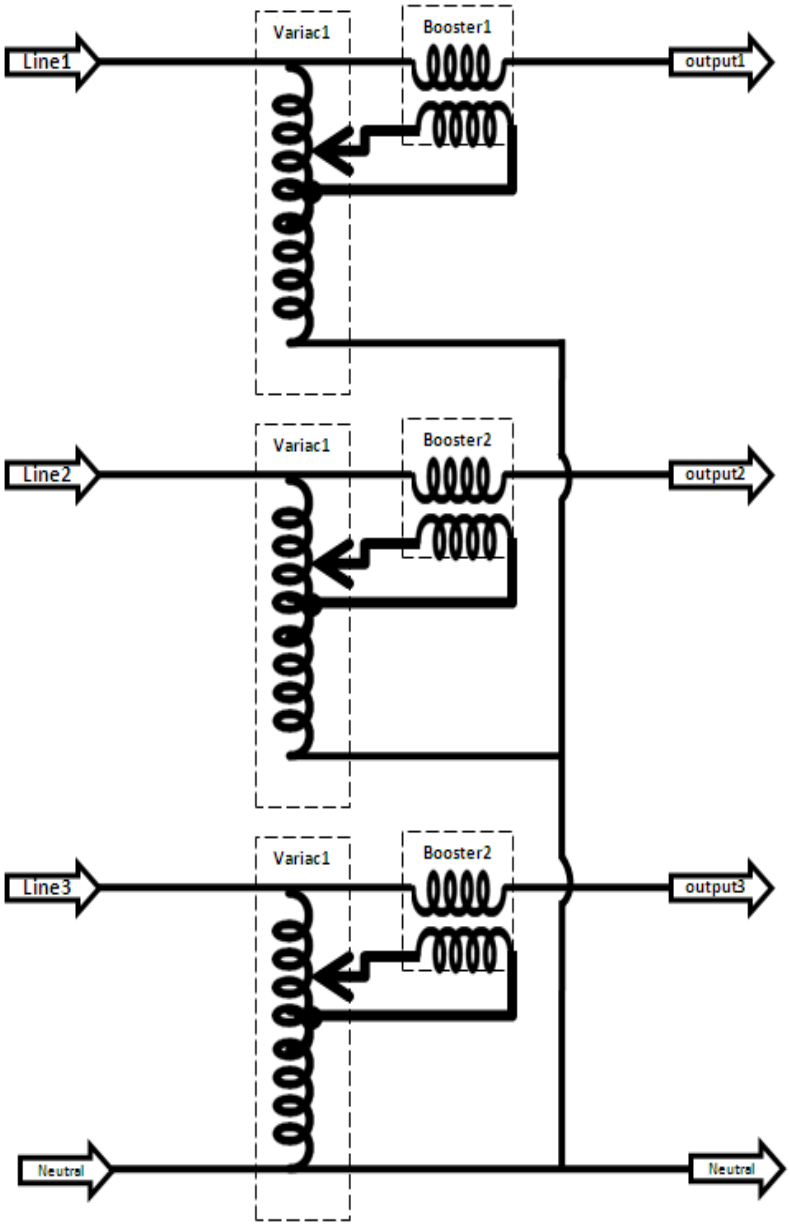
**The control board will produce control signal applied on servo motor in order to regulate the measured output voltage to the desired output.**

### When input voltage is applied to the stabilizer, the self-test operation will be initiated as the following:

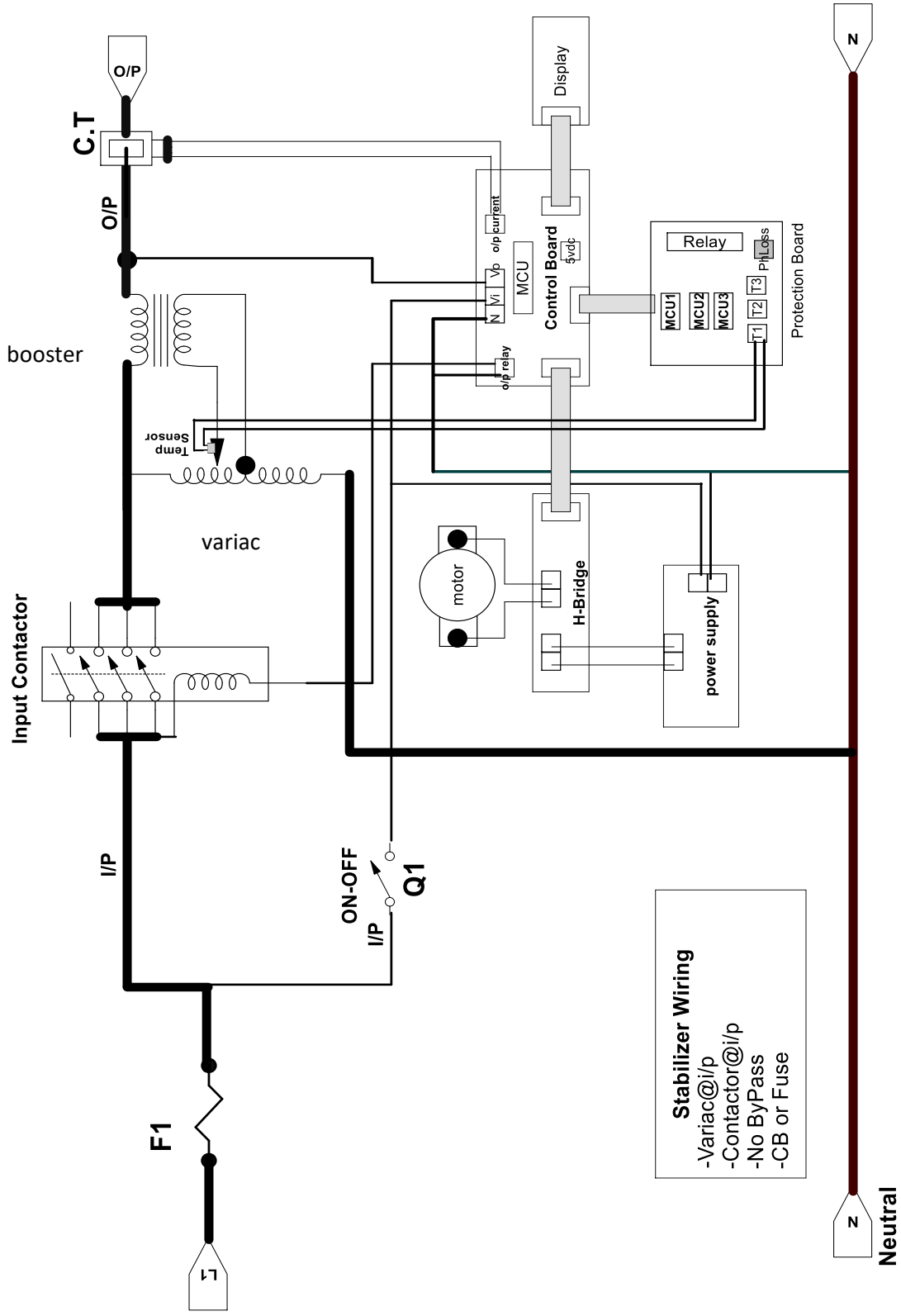
1. The MCU measures input voltage.
2. Check the validation of power connectivity of motor.
3. Check the variac mechanical motion.
4. If the steps 2 &3 are valid the control passes to the next step, but if any one did not ok this message appears on screen *"check motor"* and the control hangs up. The stabilizer needs to restart again refer *to warnings and Alarms events page16*
5. After that the control checks the validation of the input voltage window; if it out of range, this message will appear *"$V_i$ under limit" or "$V_i$ over limit"*. In this case the control waits until $V_i$ return again in the allowed range *refer to warnings and Alarms events page16*
6. The control rotates the motor **(note: rotating motor means moving the variac brush)** towards increasing or decreasing direction according to measured $V_i$ value.
7. The control finishes the moving then connecting the input contactors.
8. At this step the output voltage is available then the control starts correcting operation if it is required.
9. The correcting operation depends on the error between the measured voltage and the target value *(nominal output voltage)*.
10. The moving of motor depending on the calculated error value.
11. The MCU measures the output current and provide the protection against over loading.

12. **Note:** The target from this motion before connecting the input contactors is reaching the nearest contact point to the required contact point. Also it considers load protection against high voltage because the output voltage is not available.

The following figure illustrates the electrical wiring of three phase stabilizer. Each phase contains variac and booster (power parts)



## 2.2. Electrical wiring of single phase.



## 2.3. Technical Specifications.

| | |
|---|---|
| **Input Voltage Range** | **275 – 460VAC standard window or Customized** |
| **Output Voltage** | **380 VAC ± 1.5%** |
| **Output Voltage Adjustment** | **380 nominal voltage [ adjustable ]** |
| **Operating Frequency** | **50-60 Hz ± 5%** |
| **Overloading** | **150 % for 10sec** |
| **Regulation Speed** | **~90VAC / Sec** |
| **Efficiency** | **> 98%** |
| **Operating Technique** | **PWM controlled DC motor by microcontroller** |
| **User Interface** | **LCD Display + 5 Buttons + 4 RGB LEDs.** |
| **Warnings** | **High/Low Input voltage, Overload.** |
| **Alarms** | **High/Low Input voltage, Overload (after timer), over temperature.** |
| **Measurement Values** | **Input/output Voltage, Output Current** |
| **Protection** | **Overload, Over/Under Voltage, Thermal Protection.** |
| **Operating Temperature** | **-10°C to 50°C** |
| **Humidity** | **95%** |
| **Operating Altitude** | **Up to 1000 m.** |
| **Noise Level** | **< 50 db at 1 mt.** |

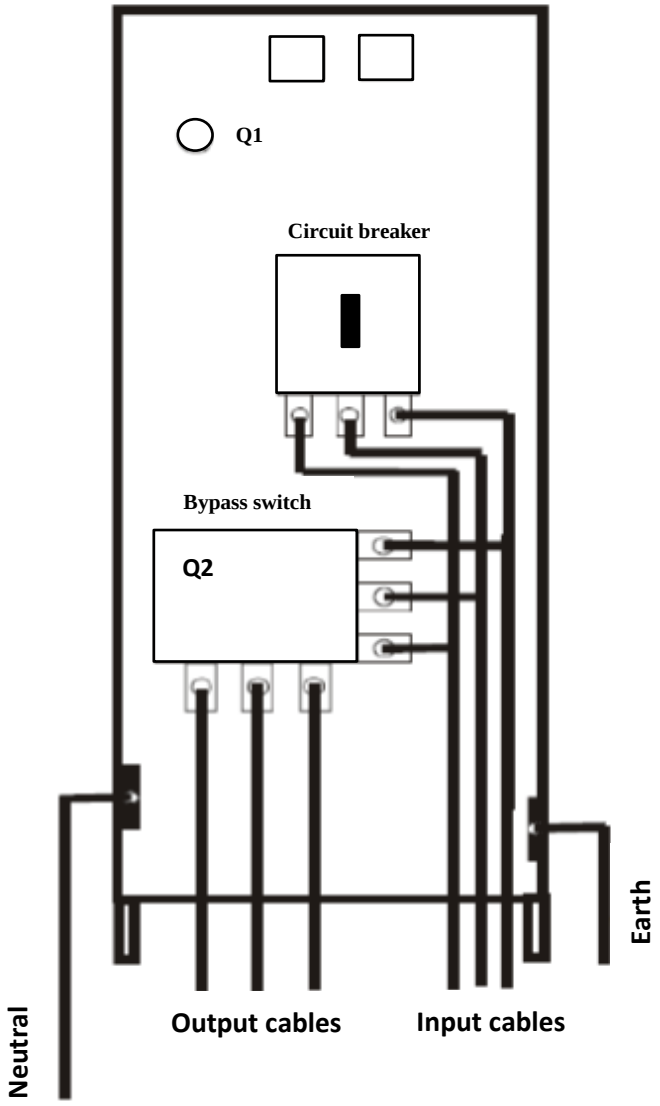
# 3. Line Stabilizer User Instruction

## 3.1. Installation Instruction.

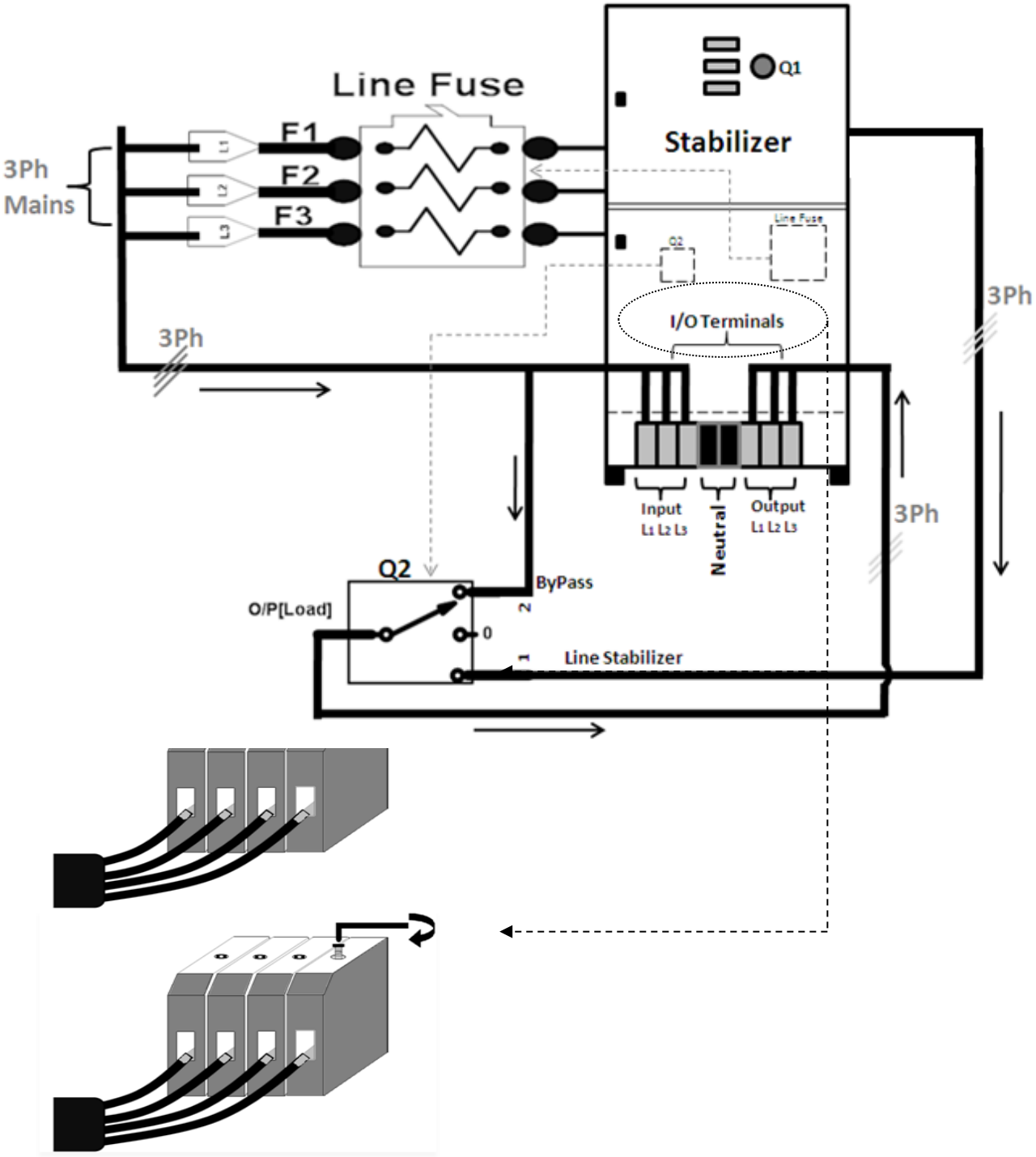
- Make sure that the Input and output power cables connections have the correct cross section to carry the full load current.
- To guarantee efficient air circulation, there must be an adequate empty space around the stabilizer for safety and air flow.
- Follow the *standard installation procedure* carefully before start up the Line Stabilizer.
- Check the correct input sequence (Phase Rotation), in case three phase loads.

## 3.2. Standard Installation procedure.

**For power rating ≥ 300KVA.**



**For power rating < 250KVA**



### 3.2.1. Before operation.

- Make sure that all circuit breakers or fuses are in “off position”.
- Make sure the rates of the circuit breakers, the fuses and the cables are suitable.
- Use suitable tools to tie all the cables inside the terminals.
- Connect the power line cables to the input terminals of the Line Stabilizer.
- Connect the output power cables to the output terminals of the Line Stabilizer.

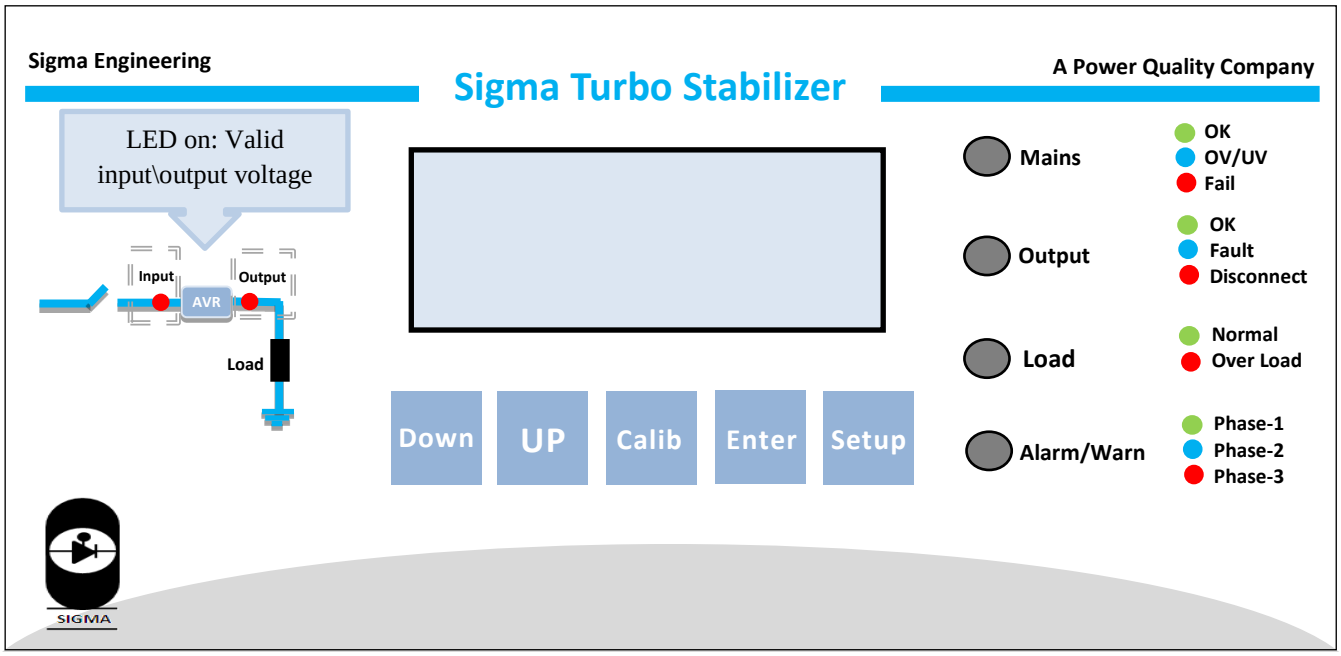
### 3.2.2. Start Up.

- Turn Q2 “Bypass switch” to [**0**] position (the output voltage is not available).
- Connect the input circuit breaker or line fuse.
- Push Q1 ”Circuit breaker”.
- Observe on the front panel display this message *“Self test….” And then “Self test ok”.*
- Select the desired nominal output voltage and protection level.
- Turn Q2 “Bypass switch” to [**1**] position (Line stabilizer position).

### 3.2.3. Total shutdown.

- Release Q1 ”Circuit breaker”.
- Disconnect the input circuit breaker or fuse holder [for safety].
- Turn Q2 “Bypass switch” to [**0**] position.

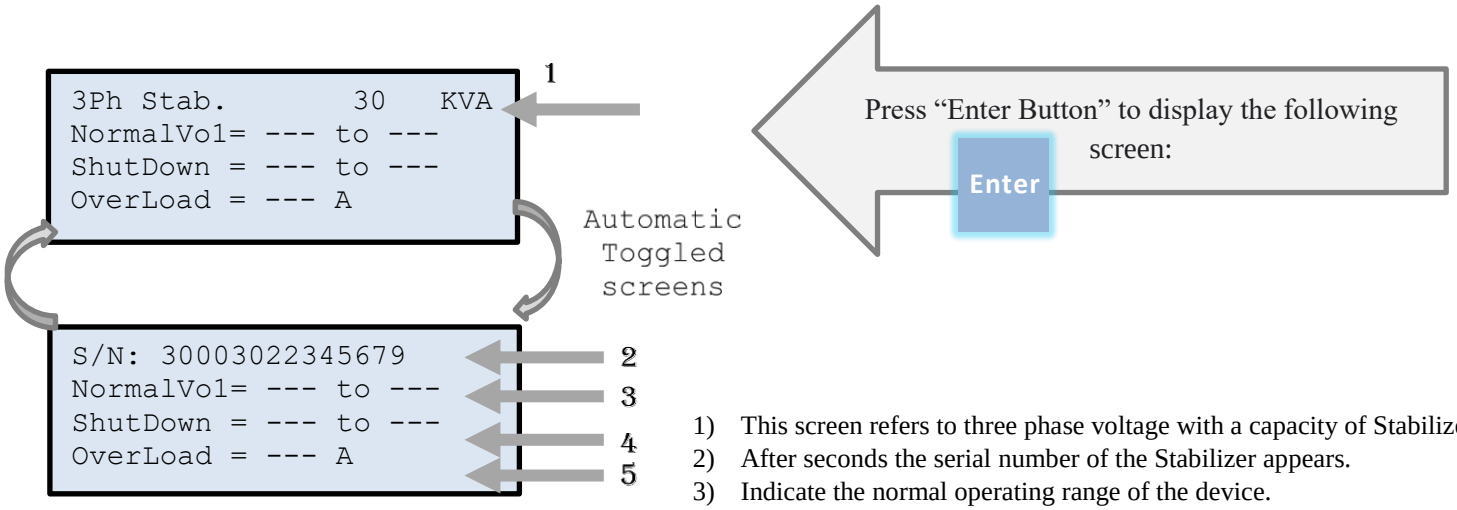
# 4. Front Panel User Instruction




| CONTROL | FUNCTION |
|---|---|
| Down Button | Used to navigate screen Down, and increment value in setup/Calib mode. |
| UP Button | Used to navigate screen UP, and navigate the pointer in setup/Calib mode. |
| Calib Button | It is used to calibrate the voltage stabilizer, Specific to the manufacturer. |
| Enter Button | Display the device Data. |
| Setup Button | It is used to adjust the voltage stabilizer, Specific to the manufacturer. |

| MONITOR | FUNCTION |
|---|---|
| Mains LED   | OK : Input voltage is within the voltage window range.<br>OV/UV : Input voltage is near the window Limits.<br>Fail : input Voltage is out of voltage window or phase loss. |
| Output LED   | OK : Valid output voltage.<br>Fault : No output Voltage, the device needs maintenance.<br>Disconnect : No output Voltage. |
| Load LED   | Normal : Valid output Voltage.<br>Over Load : There is an over load.<br># If the LED is off, it indicates that there is no output voltage. |
| Alarm/Warn LED   | Each phase has a color, Phase1: green, Phase2: blue and phase3: red, so if a problem occurs at any phase, the RGB LED will illuminate the color assigned to each phase. |

- **Device Data:**

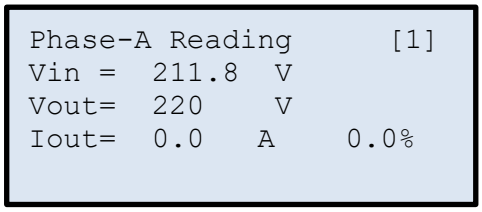



1) This screen refers to three phase voltage with a capacity of Stabilizer.
2) After seconds the serial number of the Stabilizer appears.
3) Indicate the normal operating range of the device.
4) Indicate the limits of voltage range.
5) The maximum current that the voltage stabilizer can withstand.

# And these data are pre-defined according to the customer’s request.

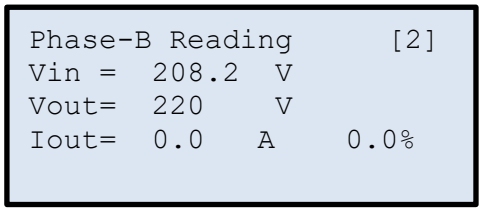
## • Measuring Data:

- Navigate throw screens by “Down/UP Button”.

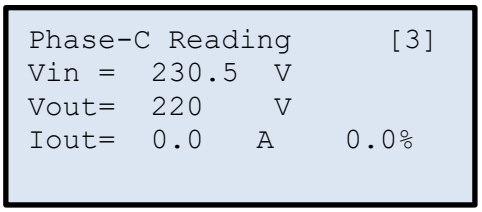



This screen indicates the data for phase voltage A:

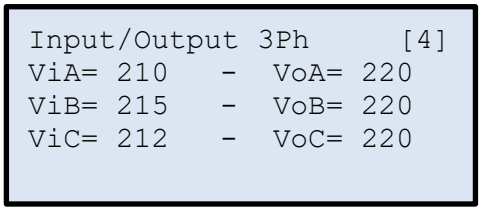
1) “Vin” : Value of the input voltage.
2) “Vout”: Value of the output voltage.
3) “Iout”: value of the load current.
4) “0.0%”: Ratio between load current and the full load current.



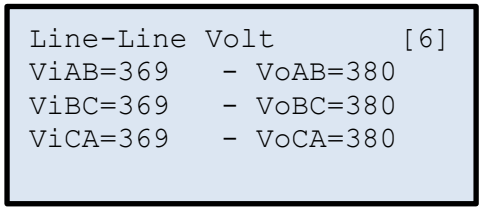

This screen indicates the data for phase voltage B, as shown previously.



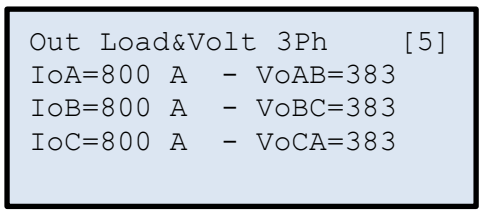

This screen indicates the data for phase voltage C, as shown previously.




This screen indicates the values of phase voltages: VA\VB/VC.

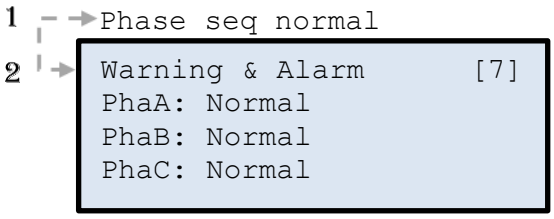



This screen indicates the values of Line to Line input / output voltage: $VAB_{L-L}$ \$VBC_{L-L}$ /$VCA_{L-L}$.




This screen indicates the values of Load current for each phase $I_{oA}$/$I_{oB}$/$I_{oC}$
And the Line to Line output voltage: $VAB_{L-L}$ \$VBC_{L-L}$ /$VCA_{L-L}$.

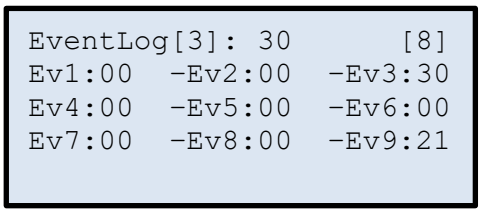
- **Alarm & warnings:**




The first line toggled between 1&2.
This screen indicates the status of the device on each three phases, and the following table shows the devices alarms:

| Alarm List | |
|---|---|
| WarnOverLd | There is an over load, &the stabilizer will disconnected if the overload continues. |
| OverLoad | The stabilizer is disconnected because it is over loaded. |
| ErrWaitMode | Internal problem with stabilizer requires the maintenance team. |
| TEMP | The stabilizer is disconnected because the high temperature. |
| CutLowVin | The stabilizer is disconnected because the min. input voltage has been exceeded. |
| CutHighVin | The stabilizer is disconnected because the max. input voltage has been exceeded. |
| WrnLowVin | Minimum input voltage is approaching, but the stabilizer is still turned on. |
| WrnHighVin | Maximum input voltage is approaching, but the stabilizer is still turned on. |
| *Normal* | There is no problem in the stabilizer but the phases reversed. |
| Normal | The stabilizer is working normally. |
| Phase seq normal | No problem at the phases direction. |
| Phase seq rev | The phases reversed. |

- **Event Log**




This screen indicates the history of the faults, there are nine digits for the memory, the first digit refers to the number of phases, and the second refers to the fault like the following:

| List of malfunctions | | |
|---|---|---|
| Stand_by | 0 | The stabilizer is disconnected because the min. or max. Input voltage has been exceeded. |
| ErrWait_Mode | 2 | Internal problem with stabilizer requires the maintenance team. |
| OverCurrentMode | 3 | The stabilizer is disconnected because it is over loaded. |
| OverTempMode | 6 | The stabilizer is disconnected because the high temperature. |

Notes:

- When the stabilized is shutdown due to the output voltage goes over or under specific threshold (OV/UV limits) the self test will be start again before resuming.
- When the stabilized is shutdown due to over loading. **The stabilizer should be restarted manually again.**

- Tripping Curve.(adjustable)

| OverLoad Tripping Curve | |
|---|---|
| **Percentage Overload** | **Time** |
| **100% - 110%** | **7Min** |
| **110% - 120%** | **6Min** |
| **120% - 130%** | **5Min** |
| **130% - 140%** | **4Min** |
| **140% - 150%** | **3Min** |
| **150% - 200%** | **2Min** |

# 5. Optional Accessories

- **Input circuit breaker:** A molded case, manually operated, thermal magnetic**.**
- **Output circuit breaker:** A molded case, manually operated, thermal magnetic**.**
- **TTVS:** Transient voltage surge& spike suppression protection against damaging voltage spikes and transients**.**
- **Phase Failure Protection:** any failure of phases the Stabilizer will power down to protect the loads automatically**.**

# 6. Maintenance Procedure


A servo stabilizer like other electrical equipment, need to periodic maintenance as following.

1) Release Q1 “Circuit breaker”( or ON/OFF switch in front of stabilizer) and input circuit breaker or line fuse.
2) Switch “OFF” Q2 ( by pass switch ) to [**0**] position.
3) Disconnect the three phase main source.
4) Open the covers of the line stabilizer and clean with air compressor the dust carefully.
5) Clean the variable transformer “VARIAC” if it required.
6) Check the cooling fans.
7) Check the micro limit switches on the variable transformer “VARIAC”, if there’s a failure in their ON-OFF action, please replace.
8) Check all mechanical cable connections and Ground-Case connections for safety.
9) Check the electronic Control PCB connections and tighten the connectors.
10) Push Q1 “Circuit breaker” ( ON/ OFF switch) and switch Q2 ( by pass switch )to position [1].
11) Switch Q2 ( by pass switch ) to [2] by pass position, if some parts need maintenance by manufacturer. This state is considered as emergency case.