SHIMATSU

JAPAN TECHNOLOGY

ROTARY ELECTRIC CONVERTER

(THREE PHASE)

The contents of this document are subject to revision without notice due to continued progress in methodology, design, and manufacturing.

IMPORTANT

SAFETY WARNING

ROTARY ELECTRIC CONVERTERS OPERATE AT MAINS VOLTAGES. INSTALLATION, CONNECTION AND MAINTENANCE MUST BE CARRIED OUT BY SUITABLY QUALIFIED PERSONNEL ONLY AND IN ACCORANCE WITH GOOD ENGINEERING PRACTICE.

IT IS IMPORTANT THAT THE INSTRUCTION MANUAL IS CAREFULLY READ BEFORE ANY WORK IS COMMENCED

NOTE: Before first time switching ON the Rotary Electric Converter must be visually inspect both externally and internally. This is to ensure that there has been no damage or that there is no dust or other foreign objects that have accumulated during transportation or installation. Pay particular care to the variable transformer brushes and tracks.

NOTE: Ensure that the Rotary Electric Converter is connected to a good protective earth.

NOTE: Ensure that the installation location of the Rotary Electric Converter allows adequate ventilation and is not causing overheating.

NOTE: The Rotary Electric Converter may not be installed in an explosive material area or in an inflammable gas environment.

NOTE: Ensure that the Rotary Electric Converter has *Normal-By Pass* (also marked as *Stable-Line*) transfer function. No work should be commenced at live line conditions.

NOTE: Before installation Rotary Electric Converter, desiccant agent (Silica Gel) bag and residual matter should be removed from Rotary Electric Converter and surely inspected.

Table of content

1. Introduction
2. Features
3. Specifications
3.1 Electrical specifications
3.2 Mechanical specifications
4. Technical guide
4.1. User Interface
4.2. Part location
4.3 Control board
4.4 Auto transformer
4.5 Voltage control board (PCB1)
4.6 Over, under voltage protection board (PCB2)
5. Principle of operation
5.1 Design
5.2 Electrical principle diagram
5.3 Monitor and control circuit
5.4 Over, under voltage protection principle
5.5 Other protection circuit
6. Installation, Adjustment and Operation
6.1. Installation procedure
7 Maintenance

1. Introduction

STB Series Rotary Electric Converters are designed and manufactured utilizing advanced compensation technique. The Rotary Electric Converter's offer high capacity and high efficiency. They are easy to operate, require simple maintenance and offer high reliability. The Rotary Electric Converter can match any load type, especially unmanned operation of equipment in telecommunication centers. The Rotary Electric Converter's provide stable output voltage supply for electronic equipment such as telecom base station, CNC machines, computerized topography, printing machines, production lines and others.

For up to 500KVA capacity STB Series Rotary Electric Converter's employ roller type brush. The electrical design combines three phase overall control with independent phase adjustments.

2. Features

- 32bit microprocessor control system (ARM Cortex-M3)
- Wide input voltage range.
- Wide load power factor range (resistive, capacitive, inductive).
- Continuous operation and short time over load rated.
- Long life roller type carbon brush.
- Negligible wave distortion to the output.
- Isolation transformer can be connected at the input or at the output of the Rotary Electric Converter.
- The △/Y or Y/△ isolation transformer option offers 3rd harmonic rejection.
- Protection circuit (over, under voltage and over current with shutdown delays).
- Manual By-Pass. Normal (Stable) breaker and By-Pass (Line) breaker are mechanically interlocked.
- Vacuum pressure impregnation process for F or H class insulation of the magnetic components.
- Surge protection option is available on request.
- Multiple outputs or other output voltages are available on request.

3. Specifications

3.1Electrical specifications

- **Input voltage range:** Maximum allowed280V-450Vac 50Hz
  Non-destructive 0-500Vac 50Hz
- **Input frequency range:** 50Hz +/-5Hz
- **Nominal output voltage:** Three phase 380Vac 50Hz
- **Over voltage shutdown:** Output voltage >253Vac (+15%), 4-7s delay before cut off.
  Automatic restart when mains voltage decreases.
- **Under voltage shutdown:** Output voltage< 176Vac (-20%), 4-7s delay before cut off.
  Automatic restart when mains voltage increases.
- **Output voltage accuracy:** Selectable ±1% to 5%.Factory preset at ±1.5% Long term Stability: <±2%
- **Overload protection:** Automatic circuit breaker rated at 130% Overload capability for heavy start load.
- **Manual By-pass:** Rated for 130% nominal current.
- **Efficiency:** >98% (Without isolation transformer).

3.2 Mechanical specifications

Environment:

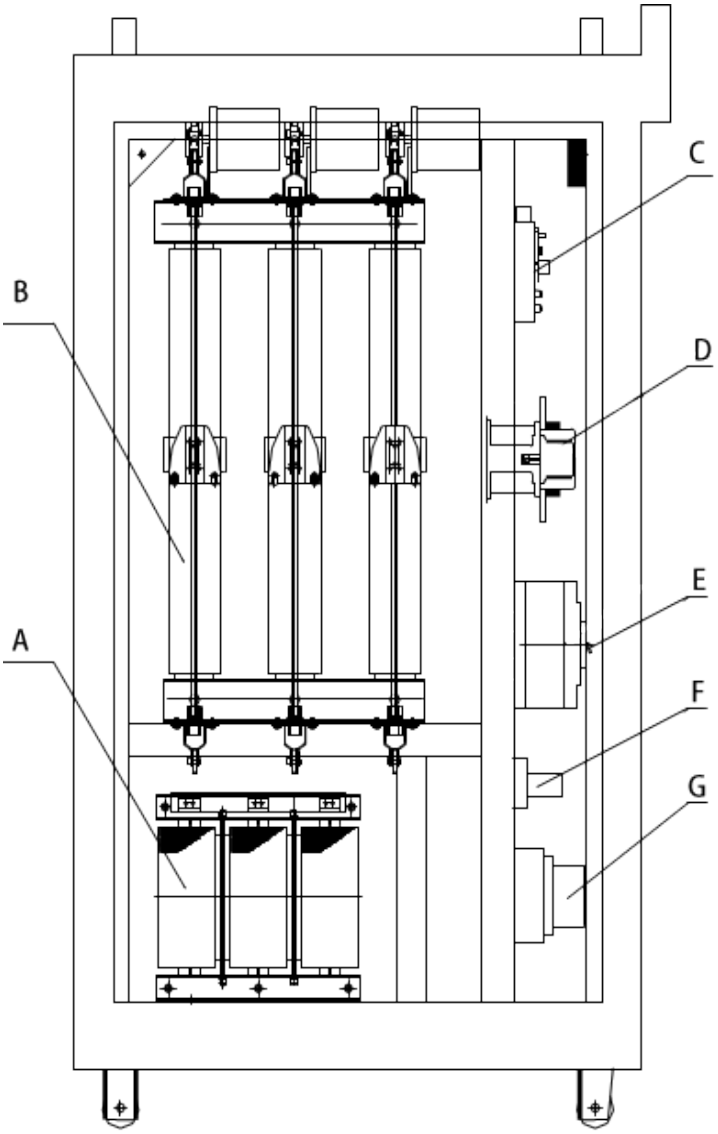
- **Protection class:** IP20
- **Electrical safety:** CE equivalent
- **Ambient Operating temperature:** -20 °C to +45 °C
- **Relative humanity:** <90%

Dimensions:

Serial No.	Rating* (kVA)	Dimensions (mm) (W×H×D)
STB -30KVA-F	30	300×1270×720
STB -50KVA-F	50	300×1270×720
STB -80KVA-F	80	300×1270×720
STB -100KVA-F	100	300×1270×720
STB -150KVA-F	150	400×1600×900
STB -200KVA-F	200	400×1600×900
STB -300KVA-F	300	500×1800×1050
STB -400KVA-F	400	500×1800×1050
STB -500KVA-F	500	600×2000×1250

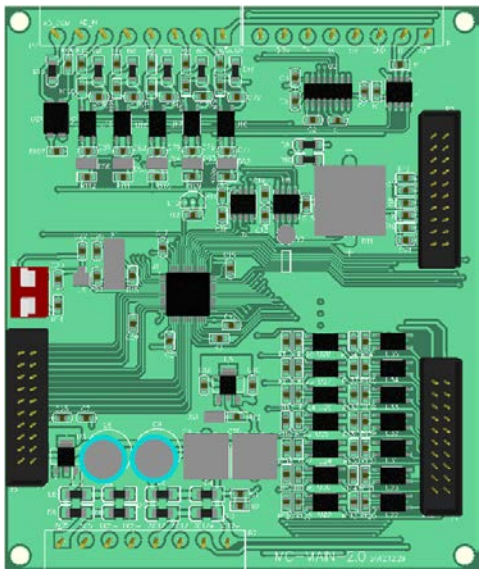
4. **Technical guide**

4.1 Parts Location

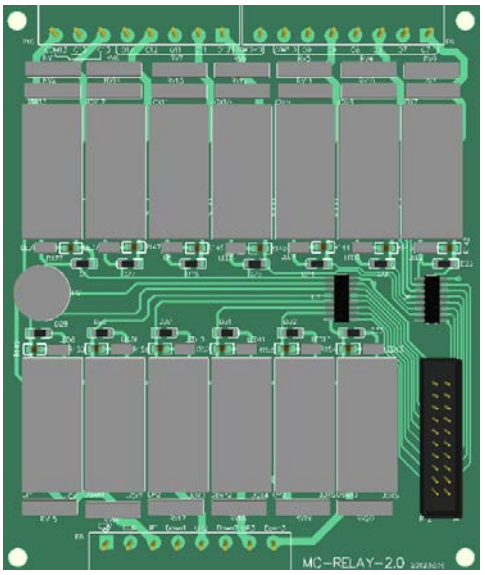


NO.	Function
A	Compensation transformer(T1a、T1b、T1c)
B	Auto transformer(T2)
C	Control board
E	Normal circuit breaker(QF1)and By-Pass circuit breaker
E	Contactor(KM)
F	Current instrument transformer(TAa ,TAb, TAc)
G	Input and output terminals (XT)

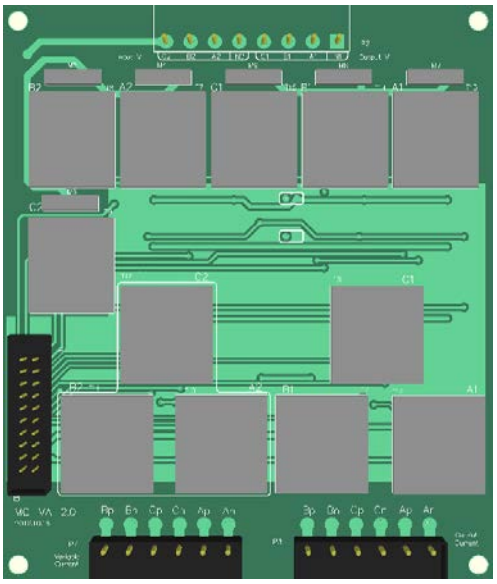
4.2 Control board



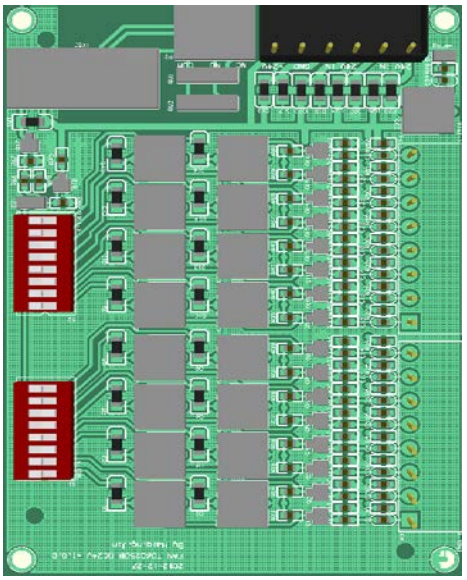
Main Control PCB



Relay PCB



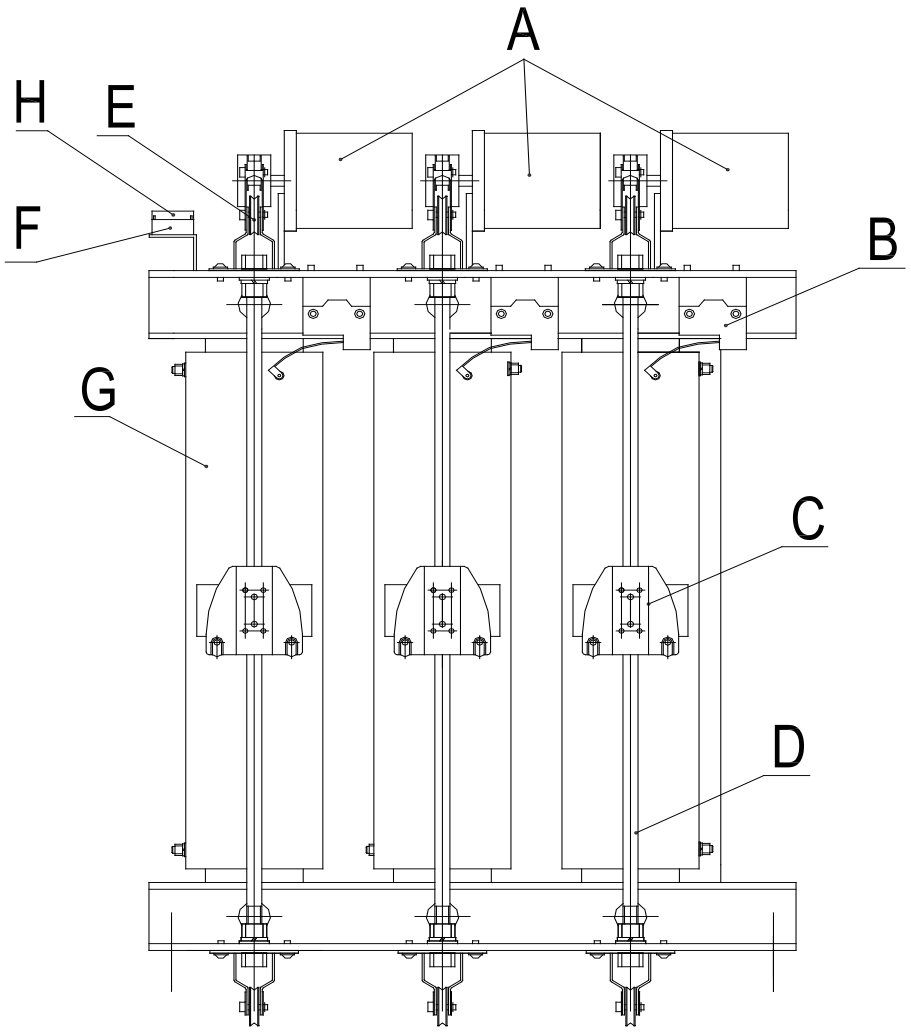
Sample PCB



Fans Check PCB

No.	Item	Function
1	Main Control PCB	All the data's computing center
2	Relay PCB	Control the contactors ,motors action
3	Sample PCB	Samples the voltage and current
4	Fans Check PCB	Check all the fans

4.3 Variable auto transformer



A	Motor(Ma, Mb, Mc)
B	End stop switch(SA4, SA5)
C	Carbon brush
D	Screw adjustment for spanning steel cable
E	Steel cable
F	Plug socket for motor (Xpa)
G	coil
H	Capacitor (C)

5. Principle of operation

5.1 Design

The converter consist of compensation transformer, variable autotransformer: isolation transformer (optional), voltage detection and control circuit, over voltage and under voltage protection circuit, servomotor and driving mechanism. (Fig 1)

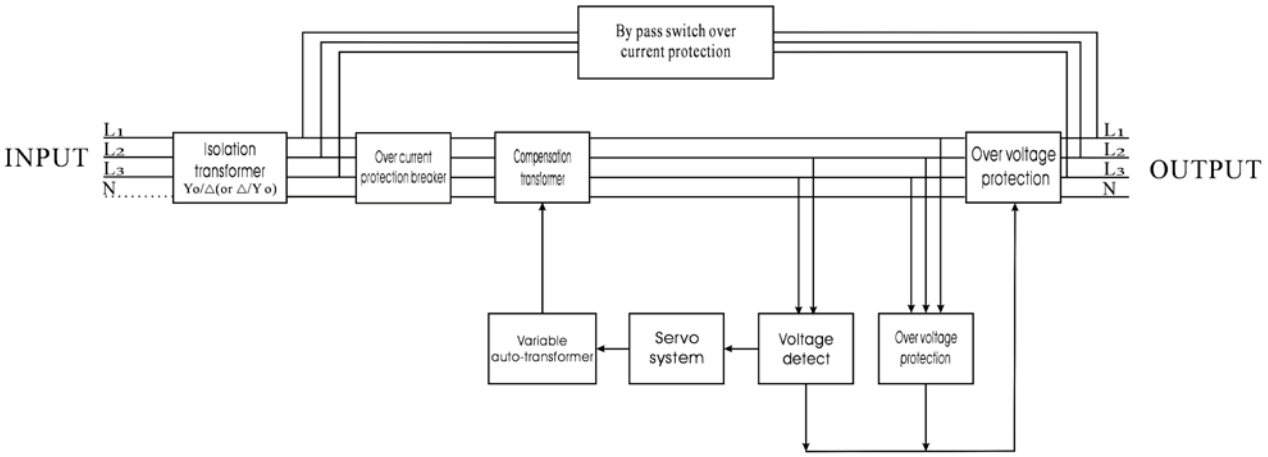


Fig 1

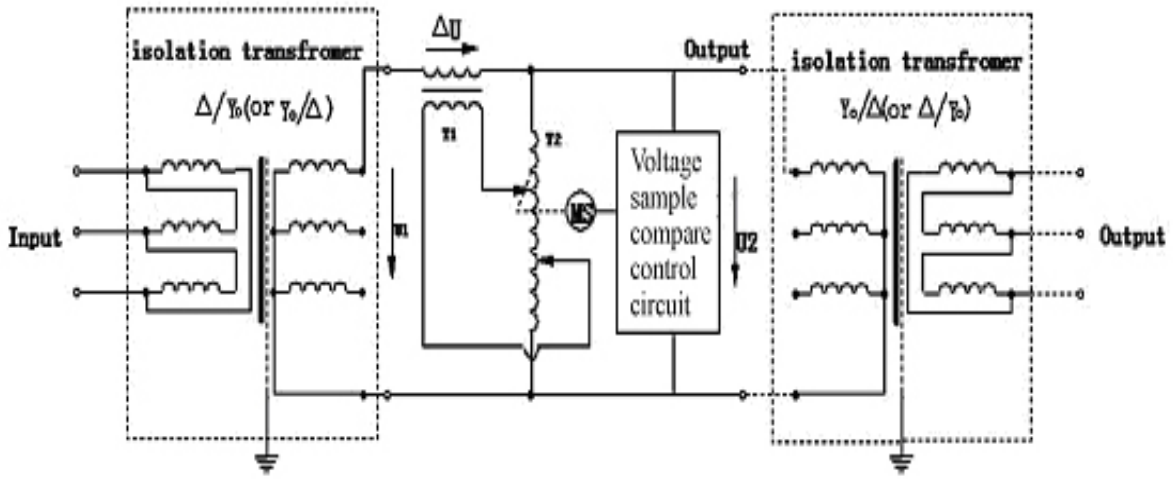


Fig2. Electric principle diagram

The converter consist of compensation transformer T1 and regulator T2. Refer to Fig2. U2=U1±△ U, where: U1 is input voltage, U2 is output voltage and △U is compensation voltage.

When the input voltage and/or the load are varied the output voltage is maintained constant by adjusting the compensation voltage. Sample of the output, after it has been rectified and filtered, is compared with the reference voltage. The amplified difference is then used to control the motor drive and move the brushes along the autotransformers

conducting surface. Such change to the input voltage of compensating transformer allows the output voltage to remain within the required range. The control is maintained in both directions.

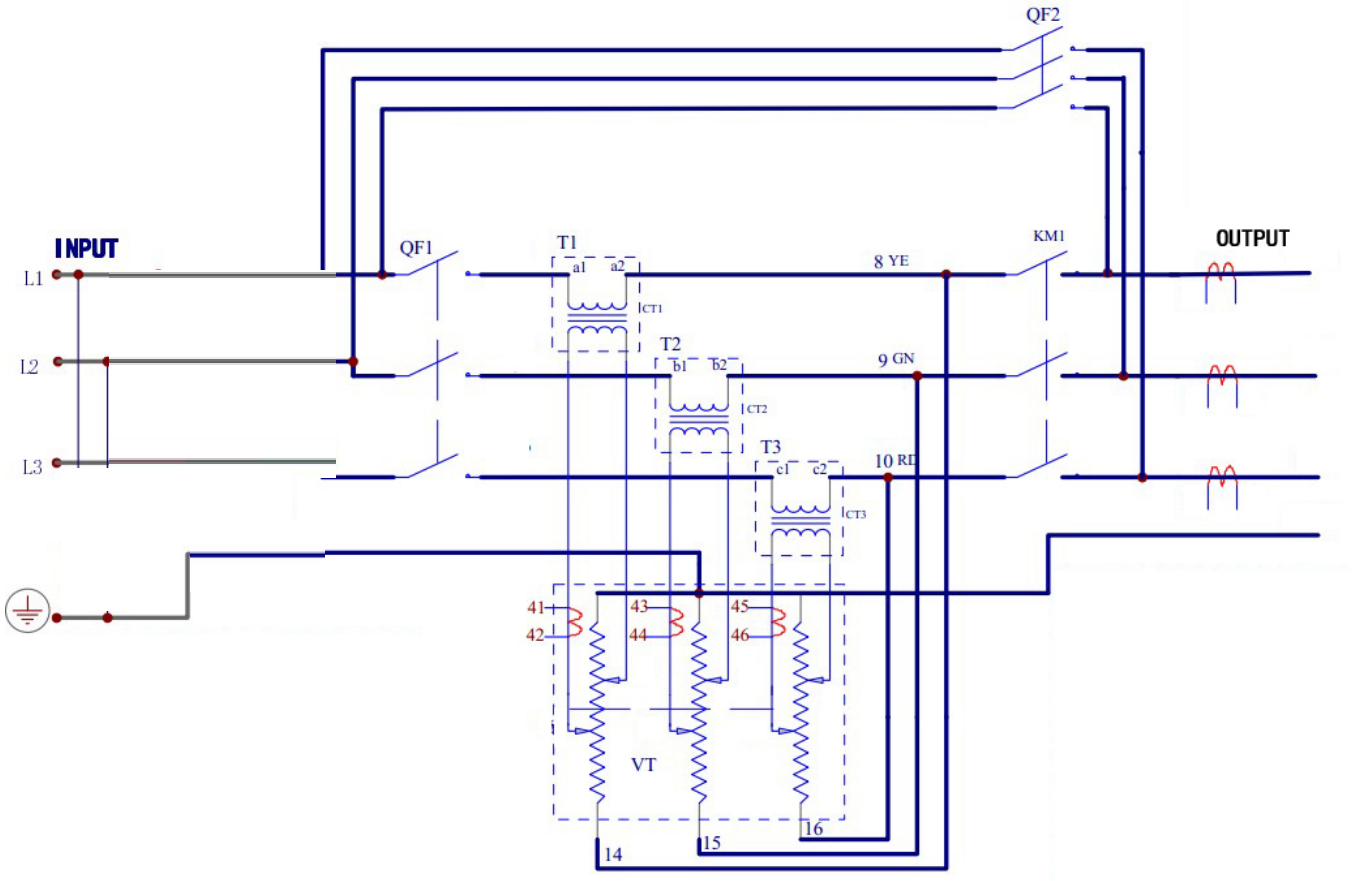


Fig3.Main Circuit Diagram of Three Phase converter
(Subject to change without notice)

Note:

1: QF1 (Normal) and QF2 (By Pass) are mechanically interlocked.
2: T1, T2, T3 are compensation transformers.

6. Micro-controller System

6.1 Basic Function:

No	Function	Description
1	Stabilization	Stabilize the voltage and then output
2	Stop	Stop Power output
3	Auto Recover	Go back to Stabilization state when fault disappears

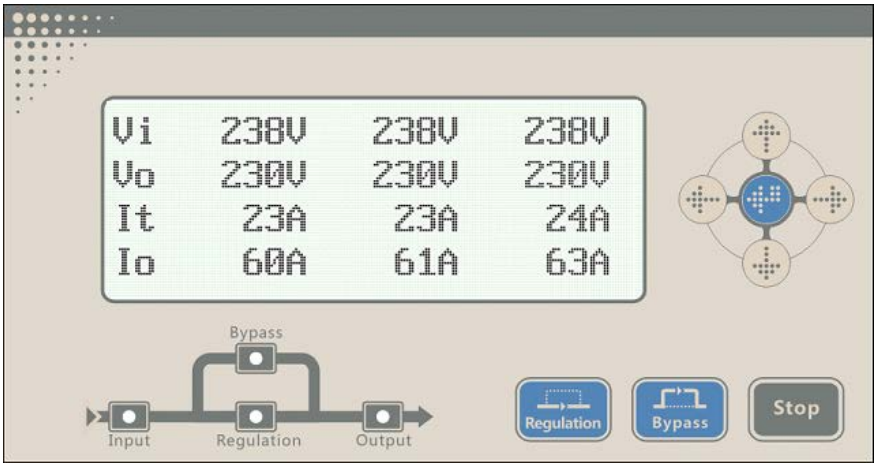
6.2 Working Step when power-on

1st: three-phase self-checking one by one;
2nd: Stabilize the voltage and then output;

6.3 HMI:

6.3.1 LCD Displayer and Key panel

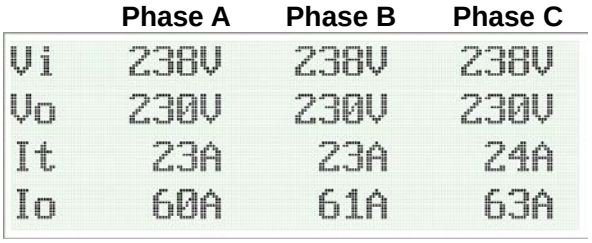
For voltage stabilize working more quickly, we reduce the speed of communication between display and the main-board, there are a delay time of 2 ~ 5 s between them. There are 5 screens in the LCD monitor.



No.	KEY	Function
1	Up	1.Move items; 2.Value plus one
2	Down	1.Move items; 2.Value minus one
3	Left	1.Last Screens 2.Move the cursor
4	Right	1.Next Screens 2.Move the cursor
5	Enter	Confirm the modify data
6	Regulation	Press the “Regulation” key, the unit will go to Regulation state after a seconds delay.
7	Bypass	No Bypass state in this Unit.(Bypass=Stop)
8	Stop	Press the “Stop”key, the unit will go to Stop state after a seconds delay.

6.3.2 Screen1: (Default)

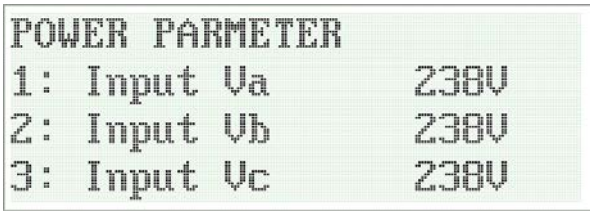
The screen1 show the input/output Voltage, autotransformer/output Current in one screen.



No.	Item	Unit	Description
1	Vi	V	Input Voltage
2	Vo	V	Output Voltage
3	It	A	Autotransformer Current
4	Io	A	Output Current

6.3.3 Screen2:

The screen 2 show the power parameter in detail.



No.	Item	Unit	Description
1	Input Va	V	Phase A input voltage
2	Input Vb	V	Phase B input voltage
3	Input Vc	V	Phase C input voltage
4	Output Va	V	Phase A output voltage
5	Output Vb	V	Phase B output voltage
6	Output Vc	V	Phase C output voltage
7	VT Ia	A	Phase A autotransformer current
8	VT Ib	A	Phase B autotransformer current
9	VT Ic	A	Phase C autotransformer current
10	Output Ia	A	Phase A output current
11	Output Ib	A	Phase B output current
12	Output Ic	A	Phase C output current
13	Active Pa	W	Phase A active power
14	Active Pb	W	Phase B active power
15	Active Pc	W	Phase C active power
16	∑Active P	W	Total active power

17	Reactive Pa	Var	Phase A reactive power
18	Reactive Pb	Var	Phase B reactive power
19	Reactive Pc	Var	Phase C reactive power
20	∑Rct.Power	Var	Total reactive power
21	Apparent Pa	VA	Phase A apparent power
22	Apparent Pb	VA	Phase B apparent power
23	Apparent Pc	VA	Phase C apparent power
24	∑App.Power	VA	Total apparent power
25	Act.Energy	Wh	Active Energy
26	SavingRateA	%	Phase A Saving Rate
27	SavingRateB	%	Phase B Saving Rate
28	SavingRateC	%	Phase C Saving Rate

6.3.4 Screen3:

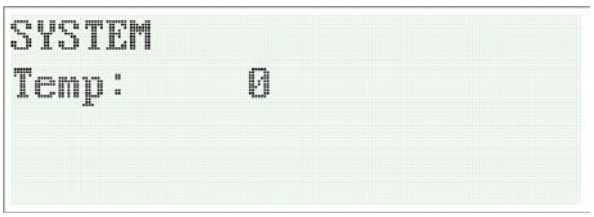
No.	Item	Unit	Description
1	Rated Voltage	V	Rated Output Voltage
2	Accuracy	%	Accuracy
3	Max Vin	V	Alarms of Maximum Input voltage
4	Min Vin	V	Alarms of Minimum Input voltage
5	Over Voltage	V	Alarms of Over Voltage(Output voltage)
6	Under Voltage	V	Alarms of Under Voltage(Output voltage)
7	Max I out	A	Alarms of Maximum output current
8	Max VT I	A	Alarms of Maximum autotransformer current
9	CT Out	/	CT value of output
10	CT at	/	CT value of autotransformer
11	Switch T	s	The time of state switch
12	Recover T	s	The time of auto recover after no failure
13	Fan Work	%	n% of autotransformer current

6.3.5 How to modify the parameters:

1. Press UP or DOWN key select a item.
2. Press ENTER key to modify.
3. Press LEFT or RIGHT key select one digit.
4. Press UP or Down key increase/decrease it.
5. Press ENTER key confirm the modification.
   There are about 2s delay.

6.3.6 Screen4:

The screen 4 show the temperature of the PCB.



6.3.7 Screen5:

The screen 5 show the failure information.
When a failure happens .The failure information will pop out on the screen.

Table of failure information:

No.	Item	Description
1	A Vin Over	Phase A input over voltage
2	B Vin Over	Phase B input over voltage
3	C Vin Over	Phase C input over voltage
4	A Vin Under	Phase A input under voltage
5	B Vin Under	Phase B input under voltage
6	C Vin Under	Phase C input under voltage
7	V out Over	Output over voltage (any phase)
8	V out Under	Output under voltage (any phase)
9	A I out Over	Phase A output over current
10	B I out Over	Phase B output over current
11	C I out Over	Phase C output over current
12	A It Over	Phase A autotransformer over current
13	B It Over	Phase B autotransformer over current
14	C It Over	Phase C autotransformer over current
15	Flash Err	Flash Rom IC in the PCB error.
16	Tran Over	Compensating transformer overheating
17	Temp Over	PCB temperature overheating
18	Vin Asymmetric	Input voltage Asymmetric
19	Fan failure	Fans broke Or Smoke sensor working
20	Other Err	No failure

***Note**: When a failure happens, The Failure information shows in the “Last Err”

6.4 Fault detection and handling:

No.	Detecting	Handling
1	Lacking phase	Delay for 6 seconds, Start the alarm and cut off the output, and then back to the end; After power back to normal it automatic recovery
2	Input overvoltage	DITTO
3	Input under-voltage	DITTO
4	Output overvoltage	DITTO
5	Output under-voltage	DITTO
6	Output over-current	Delay for 15 seconds, Start the alarm and cut off the output, and then back to the end; After power back to normal it automatic recovery
7	Autotransformer over-current	DITTO
8	Fan failures	Delay for 6 seconds, Start the alarm and cut off the output
9	Smoke Detecting	DITTO
10	Can’t Stabilization	If the unit can’t stabilize the voltage in 20s after power-on, it will alarms.
11	Overheating	When compensating transformer Overheating ,Cut off output

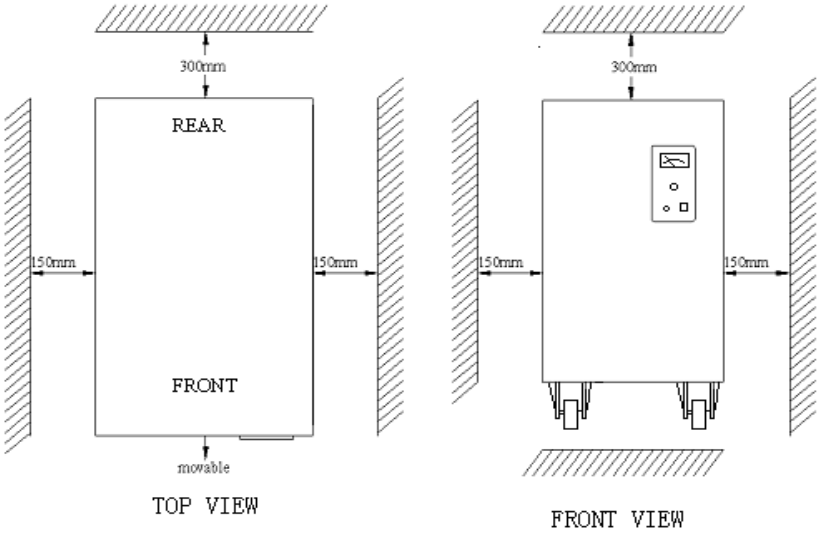
7. Installation, Adjustment and Operation

The Rotary Electric Converter should be installed in dust free, dry area with sufficient airflow for ventilation. Also see the SAFETY WARNING section.

The mains connection must have adequate capacity to match the Rotary Electric Converter's input requirements. The three phases should be well balanced.

The installation floor should be leveled to prevent the Rotary Electric Converter from sliding. Also check the floor loading capacity.

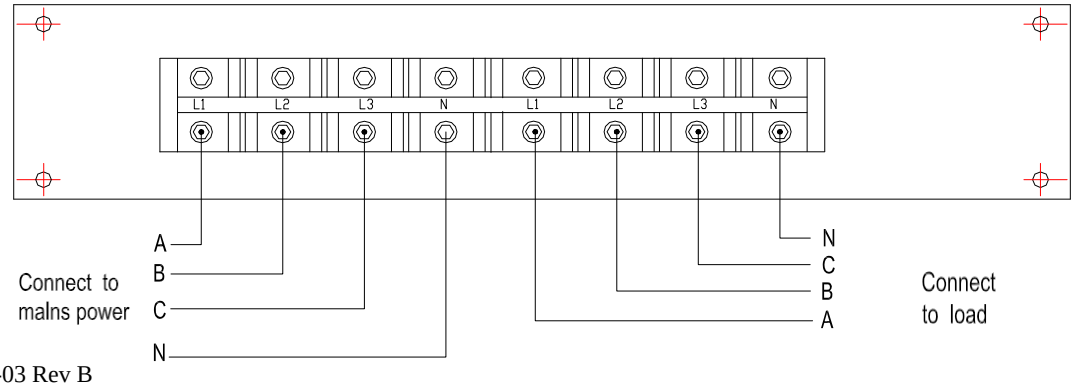
To install the Rotary Electric Converter, please confirm the distances to surrounding surfaces as per the drawing below:



Installation procedure

a. The Rotary Electric Converter when installed should be inspected carefully for physical damage during shipment, loosen screws, dust or other foreign objects. Particular attention should be paid to the roller brushes-autotransformer assembly. If necessary clean the mechanical surfaces with soft brush.
Make sure that mains supply is OFF, Normal (Stable) breaker is OFF and Output switch on the front panel is OFF!

b. Connect input and output cables to terminals marked "INPUT" and "OUTPUT", terminal marked "N" connects the output neutral wire. The terminal marked " ⏚ " connects the protective earth. The earth resistance should be less than 0,1 Ohm. See the picture below:



Size and configuration of input and output cables

Model	Input Cable Min dimension mm^2				Output Cable Min dimension mm^2				
	L1	L2	L3	N	L1	L2	L3	N	⏚
30kVA	16	16	1	1	1	1	1	1	1
50kVA	25	25	2	2	2	2	2	2	1
80kVA	35	35	3	3	3	3	3	3	2
150kVA	70	70	7	7	7	7	7	7	3
200kVA	95	95	9	9	9	9	9	9	5
300KVA	150	150	15	1	150	150	150	150	7
400kVA	240	240	24	2	240	240	240	240	120
500KVA	300	300	30	3	300	300	300	300	150

c. After the connection is completed and verified mains can be turned ON. Switch ON the Normal (Stable) breaker (QF1). Then turn ON the “Start/Stop” button on the front panel. After 1-3 seconds delay, the Rotary Electric Converter will start up and provide stabilized output voltage.
d. Check to see if each output phase voltage is OK and stable.
e. Verify the By-Pass (Line) operation. Warning: To transfer from “By Pass” or “Normal” should always first turn the power OFF. Turn ON breaker (QF2). The output of Rotary Electric Converter is directly provided from AC power line. After the verification is completed set again to Normal (Stable) (QF1). This should be the default mode of operation.
f. In case of electrical fault, overheating, loud noise, smoke or any other abnormal phenomenon, switch OFF the “Start/Stop” button and turn OFF the Normal (Stable) breaker (QF1) immediately, then turn OFF the power. Power can only be restored after the problem has been solved.

8. Maintenance

Warning: Maintenance can only be performed by qualified personnel.
Make sure that maintenance procedures are performed to an Rotary Electric Converter unit disconnected from mains.

Equipment: AC voltmeter(multimeter), electrical screwdriver set, spanners, soft brush, lubricant oil, pliers.

Intervals: The Rotary Electric Converter should be maintained (periodically) every 6 to 12 months.

Preventive Maintenance:

After every 6 to 12 months of operation the Rotary Electric Converter must be cleaned from dust and carbon powder. Pay attention to the roller brush surface and the autotransformer surface where the roller brushes are touching. Clean it with soft brush or dry cloth.

It is also essential to lubricate the gear and the drive parts with a small amount of lubricant oil every regular interval.

Inspect the mechanical fasteners and tighten any loose screws. The three brush groups should be on one level line.