SmartGen

MAKING CONTROL SMARTER

SVR440

Automatic Voltage Regulator

USER MANUAL

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Table 1 Software Version

Date	Version	Content
2024-06-12	1.0	Original release.

Table 2 Notation Clarification

Sign	Instruction
 NOTE	Highlights an essential element of a procedure to ensure correctness.
 CAUTION!	Indicates a procedure or practice, which, if not strictly observed, could result in damage or destruction of equipment.
 WARNING!	Indicates a procedure or practice, which could result in injury to personnel or loss of life if not followed correctly.

1 OVERVIEW

The **SVR440 Automatic Voltage Regulator** is a half-wave phase-controlled thyristor type automatic voltage regulator (AVR), which is part of the excitation system for the brushless AC generator. It integrates a wide range of functions in a small installation size by using surface-mount technology (SMT).

The power supply circuit of AVR uses high efficiency semiconductors to obtain the excitation voltage from the remanence. The AVR's power supply and voltage sensing utilizes separated connection terminals, allowing the excitation power to be directly supplied from the main stator winding or, if there is a requirement for continuous short-circuit current, from an auxiliary winding.

The AVR is connected to both the main stator winding and the excitation winding and provides closed-loop control accuracy of ±1% for the output voltage.

To control the generator's voltage, the AVR's voltage sensing terminal samples the output terminal from the generator winding continuously. The AVR controls the current output to the excitation system based on the sampled data, thereby changing the strength of the main rotor field, and regulates the output voltage within specified range by compensating for motor load, speed, temperature, and power factor.

The frequency measurement circuit continuously monitors the motor output, and when the motor speed drops below a preset value, low-speed protection is provided by reducing the output voltage proportionally to the speed. The under frequency protection set point can be changed by adjusting the (UFRO) potentiometer. The 50Hz or 60Hz mode can be easily selected by connecting relevant terminals with jumpers.

The built-in protection circuit of AVR controls the over excitation status within a safe time, and it has a delay function that does not make response to over excitation caused by large starting loads or transient disturbances from the load.

Connection terminals are provided for remote voltage adjustment, allowing users to achieve precise control of the generator output voltage.

There is an analog input control terminal that can be connected to a power factor controller or similar compatible device.

It can be connected with the droop current transformer to operate in parallel with other similar generators.

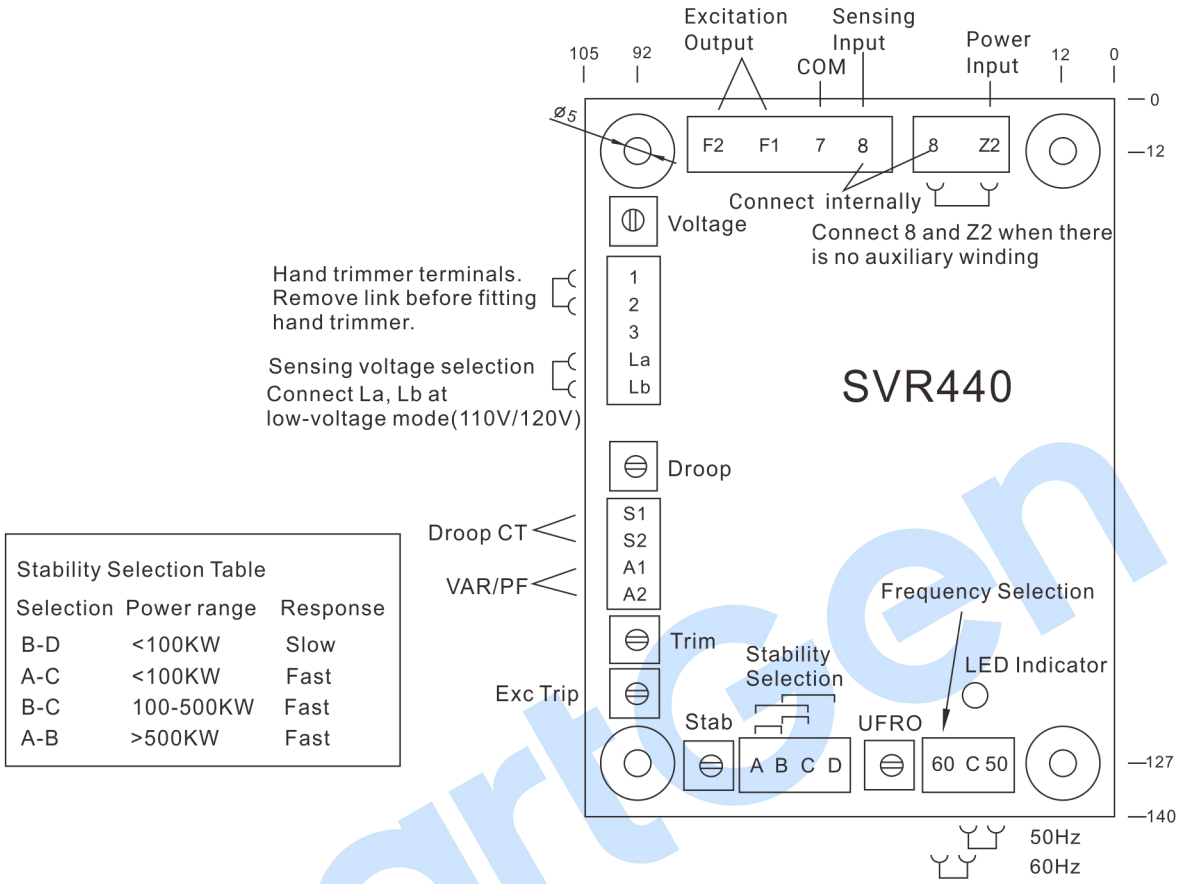
2 SPECIFICATIONS

Table 3 Technical Parameters

Item	Content
Sensing Input	Voltage: 100Vac – 130Vac 170Vac – 264Vac
	Frequency: 50Hz-60Hz (Nominal)
	Phase: 2
Power Input	Voltage: 100Vac – 264Vac ±10% 1 Phase
	Frequency: 50Hz-60Hz
Output	Voltage: Max. 82Vdc @ 200Vac Input
	Current: Continuous 4A, and transient 7.5A for 10 seconds
	Field Resistance: Min. 15Ω (Min. 10Ω when input voltage is less than 175Vac)
Regulation	±1.0% (See details in the NOTE below the table)
Thermal Drift	0.02% drift for 1% of AVR ambient temperature
Typical System Response	AVR Reponse 20ms
	90% Field Current 80ms
	97% Voltage Output 300ms
External Voltage Adjustment	With the 1kΩ per watt trimmer (Decrease the voltage by increasing the value)
	Voltage Adjustment Range: ≥±10%
Under Frequency Protection	Set point: 92%–94% rated frequency
AVR Loss	Maximum loss: 12W
Excitation Voltage	4Vac @ AVR input
Analog Input	Maximum input: ±5 Vdc
	Sensitivity: ±1V for 5% generator voltage output
	Input Impedance: 1kΩ
Droop Sensor	10Ω Load
	0.07A for 5% droop (PF=0)
	Max. Input: 0.33A
Over Excitation Protection	Default Value: 75V
	Time delay: 10-15 seconds (fixed)
Environment	Vibration: 20Hz–100Hz, 50mm/sec, 100Hz–2kHz, 3.3g
	Relative Humidity: 0°C–70°C, 95%RH
	Working Temperature: -40°C ~+70°C
	Storage Temperature: -55°C ~+80°C
Overall Dimensions	105mm x 140mm x 38mm
Installation Dimensions	80mm x 115mm x Ø5–4
Color	Black
Weight	300g

NOTE: It is within the 4% engine governing range.

3 DESCRIPTION OF CONNECTION TERMINALS



Stability Selection Table

Selection	Power range	Response
B-D	<100KW	Slow
A-C	<100KW	Fast
B-C	100-500KW	Fast
A-B	>500KW	Fast

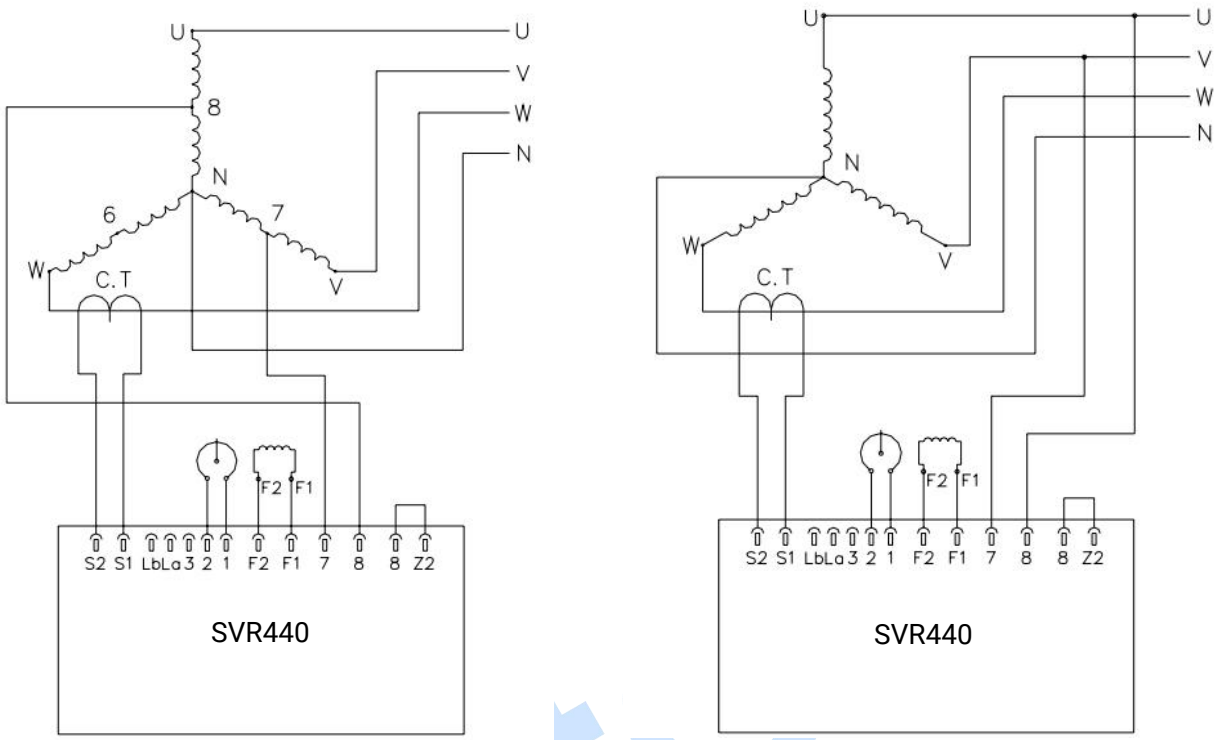
Fig.1 SVR440 Schematic Diagram

Table 4 Description of Connection Terminals

No.	Function
F2	Excitation output, F1 is the positive and F2 is the negative.
F1	
7	COM grounding terminal.
8	Sensing input.
8	Z2 is the power input, and connect the 8 and Z2 when there is no auxiliary winding.
Z2	
1	Connect with the external voltage regulating trimmer, and remove the short-connected piece before installing it.
2	
3	
La	Voltage selection of sensing input, and connect the La and Lb at voltage input of 110V/120V.
Lb	
S1	Connect with the Droop CT.
S2	
A1	Connect with the PF controller.
A2	
A	Stability selection. Connect A-B, Power range: >500KW, Response is fast;

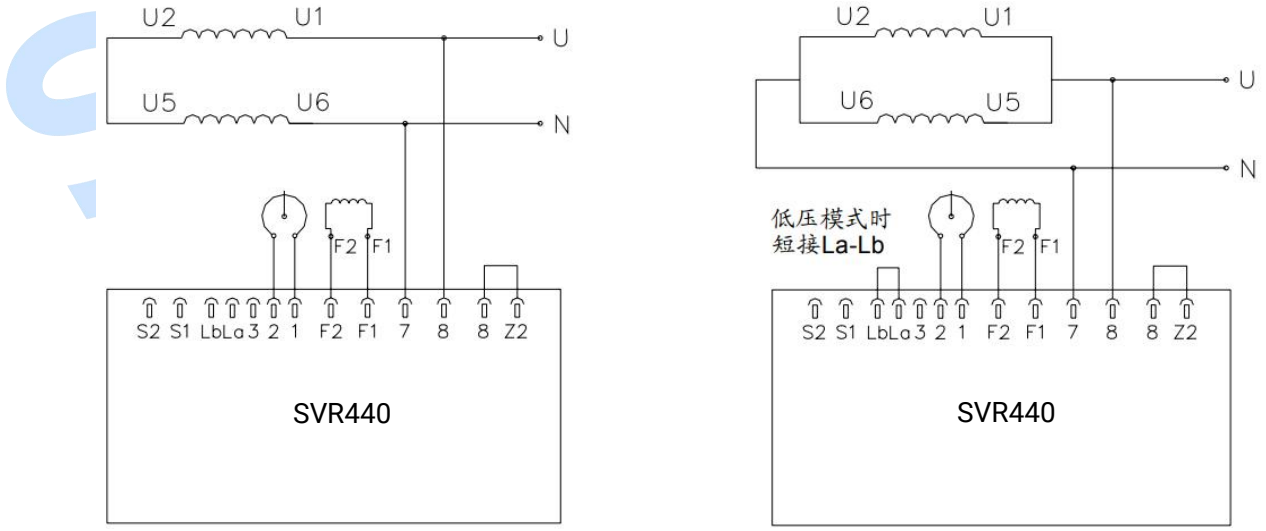
No.	Function
B	Connect A-C, Power range: <100KW, Response is fast;
C	Connect B-C, Power range: 100KW-500KW, Response is fast;
D	Connect B-D, Power range: <100KW, Response is slow;
60	Frequency selection. Connect C-50 to select 50Hz, and connect C-60 to select 60Hz.
C	
50	

4 CONNECTION BETWEEN AVR AND GENERATOR



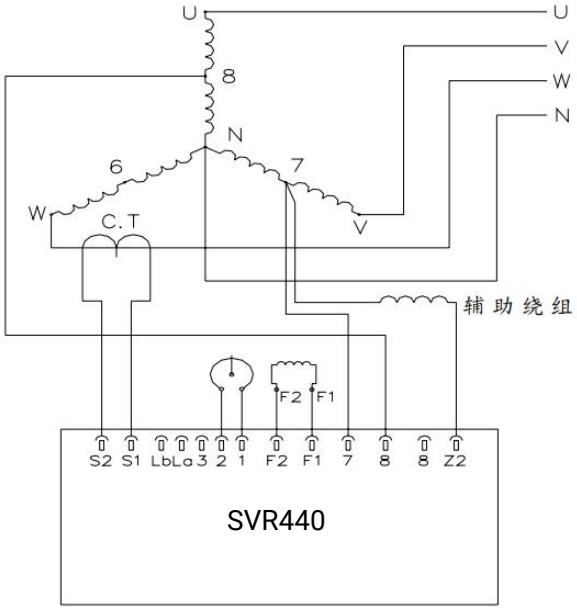
a) Wiring of generator with 12-line, 240/415V or 277/480V b) Wiring of generator with 6-line, 120V/208V

Fig.2 Wiring Diagram of 3P4W System



a) Wiring of generator with 4-line, 220V/240V b) Wiring of generator with 4-line, 110V/120V

Fig.3 Wiring Diagram of 1P2W System



(Fundamental wave auxiliary winding) Wiring of generator with 12-line, 240/415V or 277/480V

Fig.4 Wiring Diagram of 3P4W System

5 DESCRIPTION OF CONTROL

Table 5 Description Of AVR Control

Controller	Function	Description
Voltage	To adjust generator output voltage	Turn it clockwise to increase output voltage
Stability	To prevent voltage hunting	Turn it clockwise to increase stability
UFRO	To set the knee point of under frequency roll off	Turn it clockwise to reduce the knee point frequency
Droop	To set the generator droop to 5% at full load of 0 PF	Turn it clockwise to increase droop
Trim	To optimize the sensitivity to the analog input	Turn it clockwise to increase the accessory control over the AVR
Exc Trip	To set the voltage value of over excitation protection	Turn it clockwise to increase the protection voltage value

6 FUNCTION SELECTION

The following jumpers on the AVR should be checked to ensure the normal running of the generator set.

6.1 FREQUENCY SELECTION TERMINALS

Running at 50Hz Connect C-50
Running at 60Hz Connect C-60

6.2 STABILITY SELECTION TERMINALS

Select the appropriate terminal for connection (by jumper) as shown in Figure 1 or Table 4, and the factory default connection is B-C.

6.3 SENSING VOLTAGE SELECTION

Select the appropriate wiring method according to the generator type.

Connect the La-Lb by short-connected piece at the voltage input of 110V/120V.

If the power input of AVR is supplied by the fundamental wave auxiliary winding, remove the short-connected piece between 8 and Z2, and the wiring method is shown in Figure 4.

7 ADJUSTMENT OF AVR

7.1 VOLTAGE ADJUSTMENT

The output voltage of the generator is set before the factory deliver and it can be adjusted by the voltage potentiometer on the AVR or an external voltage regulating trimmer. If a large adjustment is necessary or if the voltage is unstable, please follow the voltage adjusting steps below.
If an external voltage regulating trimmer is not required, connect the Terminal 1 and 2 on the AVR.
Connect the La and Lb during low voltage sensing.

NOTE: It is not allowed to raise the voltage at a level higher than the rated voltage of the generator. If the rated voltage is unknown, refer to the generator casing nameplate for adjustment.

WARNING: No terminal (including external trimmer terminal) should be grounded, it may result in danger if not comply with this rule.

NOTE: When replacing the AVR or resetting the voltage, turn the voltage potentiometer counterclockwise to the end before starting the generator.

7.2 VOLTAGE ADJUSTING STEPS

When replacing the AVR or a large adjustment is necessary, please follow the voltage adjusting steps below.

a) Turn the voltage potentiometer counterclockwise to the end before starting the generator;
b) If the AVR is connected with an external voltage regulating trimmer, turn the voltage potentiometer to the middle position;
c) Then turn the stability selection potentiometer to the middle position;
d) Connect a appropriate voltmeter (0Vac-300Vac) with the L-N of generator;
e) Start the generator set, run the generator with no load at the nominal frequency, such as 50Hz-53Hz or 60Hz-63Hz;
f) If the red LED indicator flashes, refer to the UFRO adjustment;
g) Turn the voltage potentiometer clockwise carefully until the rated voltage;
h) If the voltage is unstable, refer to the stability adjustment. Adjust the voltage again if necessary;
i) Voltage adjustment is completed.

7.3 STABILITY ADJUSTMENT

The AVR is equipped with a stability or damping circuit to ensure good steady-state performance and transient performance of the generator.

To find the correct set point, start the generator under no load, rotate the stability potentiometer counterclockwise slowly until the voltage begins to become unstable.

The appropriate stable point should be slightly clockwise away of the unstable point (that is, the voltage is in the stable range but very close to the unstable range).

7.4 STABILITY SELECTION TERMINALS

The jumper connection of the terminals must be done correctly based on the capacity of the generator.

7.5 UFRO ADJUSTMENT

The AVR has an internal under frequency protection circuit that sends out a volts/Hz ratio when the generator's speed drops below a set value (knee point).

The red LED indicator flashes, that means the UFRO circuit is starting to work.

The UFRO adjustment is preset in the factory and sealed, and users only need to select the jumper connection for 50Hz/60Hz.

Once it is correctly set, the LED indicator will flash immediately when the frequency is below the set value. For example, it will flash when the frequency is 47Hz in a 50Hz system or 57Hz in a 60Hz system.

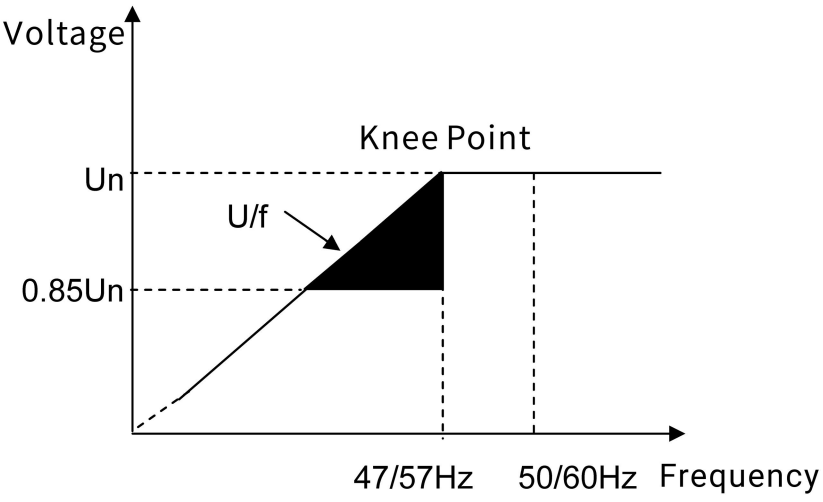


Fig.5 Under Frequency Protection

7.6 DROOP ADJUSTMENT

Motors that need to be paralleled are equipped with a orthogonal droop CT, which can provide a power factor signal to the AVR. The droop CT is connected with the S1 and S2 of the AVR.

Droop adjustment is usually preset in the factory, and the set value is 5% voltage droop when the motor is full load and the power factor is 0.

Turn the droop potentiometer clockwise to increase the CT signal input to the AVR, so as to raise the droop voltage after the power factor.

Turn the droop potentiometer counterclockwise to the end to close the droop.

7.7 TRIM ADJUSTMENT

Auxiliary inputs (A1, A2) can be connected with the power factor controller, which can accept a maximum ±5V DC signal.

⚠ CAUTION: Any device connected to this input terminal must be floating-grounded and insulated from ground with an insulation voltage greater than 500Vac, otherwise it may be dangerous to the device.

The DC input signal is superimposed on the AVR sensing circuit, and adding or subtracting depending on the polarity of the DC input signal.

The trim adjustment allows the user to adjust the sensitivity of the VPF controller.

Turn the trim potentiometer counterclockwise to the end, the VPF controller is inactive. Turning it clockwise will increase the effect of the VPF controller, and the default setting is to rotate it clockwise to the end.

7.8 EXCITATION TRIP ADJUSTMENT

The overexcitation protection adjustment is preset in the factory and sealed, generally not allowing for adjusting.

The working status of the overexcitation protection circuit is displayed through the LED indicator, which also displays the status of the UFRO.

If the generator is required to return to normal operation from the overexcitation protection status, it must be shut down and restarted.

8 OVERALL DIMENSIONS

Unit: mm

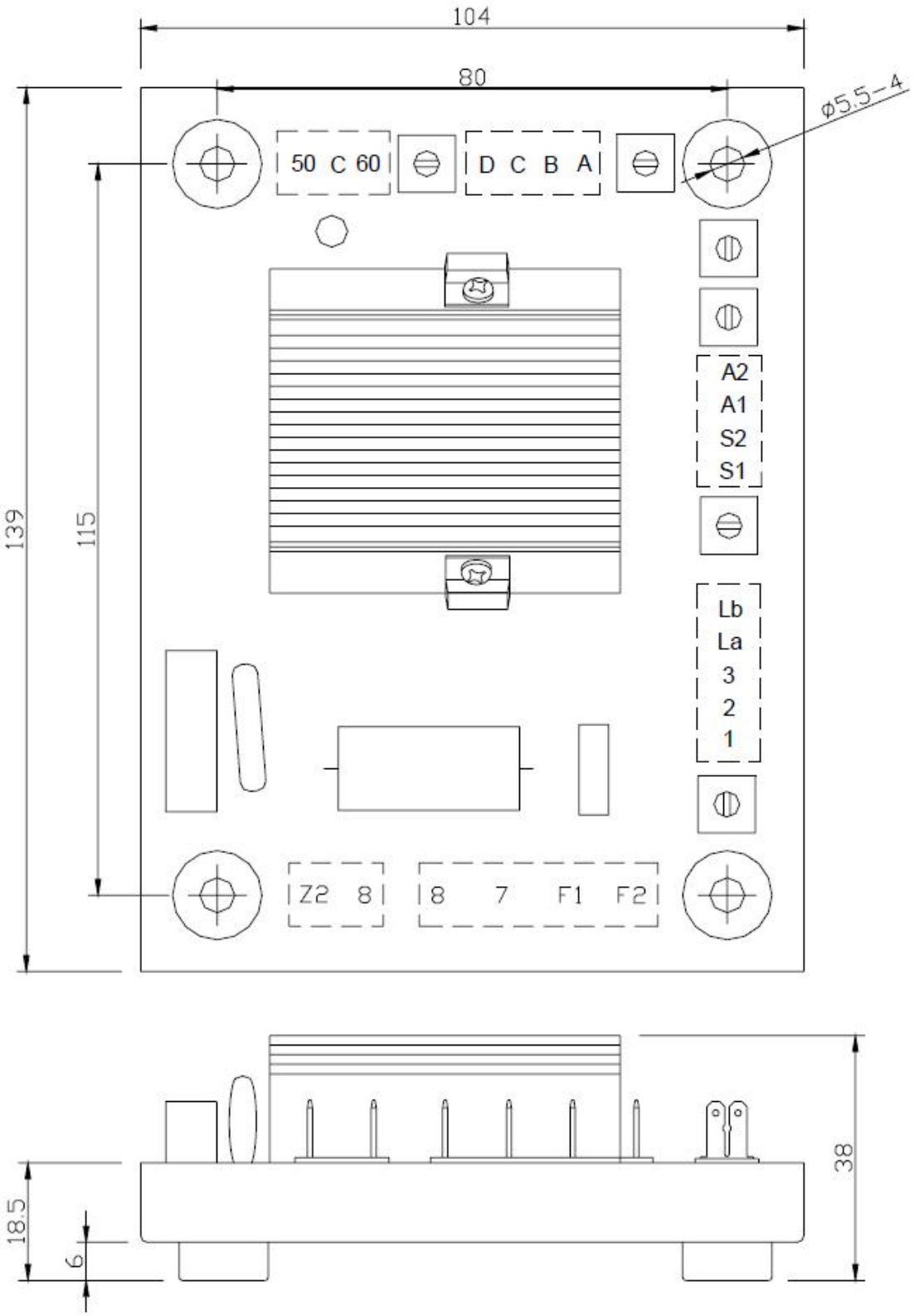


Fig. 6 Overall Dimensions