EVC800i AUTOMATIC VOLTAGE REGULATOR

Specification, Installation & Adjustment Manual

DESCRIPTIONS

The EVC800i is a 3 Phase full wave, pulse width modulated type of Automatic Voltage Regulator for regulating the voltage of Brushless Generator.
Excitation power can be derived from a shaff mounted 3 Phase premanent generator (PMG) or stator winding or Auxillary winding. Internal electrical isolation is created between the PMG inputs and sensing inputs of AVR. This isolation with the PMG assures the performance of the AVR against Non linear loads and reduces the Radio frequency interference on the generator terminals. The PMG supply enables the generator to maintain current into a short circuit.
Sensing to AVR is directly from main winding. This signal is used to control the power fed to the exciter stator (and hence to the main rotor) to maintain the generator output voltage within the specified limits. Provision is made for the connection of remote potentiometer allowing the user to find control generator output voltage.
Built up of generator output voltage is fully under control manner keeping excitation current within limits and with soft start.
A frequency measuring circuits continually monitors the speed of the generator to provide low speed protection to the excitation system. It reduces generator output voltage proportionally with speed below an adjustable threshold as per volt per hertz slope. This slope is provided adjustable and adjusted by DIP adjustment trimmer. In addition to DIP, an delayed voltage recovery (DWELL) is provided to improve speed recovery time when generator is used in conjunction with Turbo charge engines. Generator overload circuit cuts off the excitation power in the event of excessive load on generator or malfunctions. AVR observe overload condition for 20 seconds and after that cuts off the field voltage.
This condition remains latched until the generator has stopped.
For connecting 2 or more generators in parallel, quadrature droop and analog inputs provide reactive power sharing controls.

SPECIFICATIONS

Sensing Input

V_0 - V_{200} for 220 Vac, 180 to 250Vac, 50/60Hz
V_0 - V_{380} for 400 Vac, 350 to 480Vac, 50/60Hz

Power Input

PMG : 160 to 250 V, 3 Ph, 50 to 400 Hz.
Main Winding : 160 to 250 V, 1 Ph
Auxillary : 160 to 250 V, 1 Ph

Output

Voltage : 180 Vdc on Input of 200 Vac
Current : Continuous 8 Amps

Built up Voltage

Residual Voltage : >4 Vac at AVR terminal

Voltage Regulation : < ± 1 % RMS

Response Time : < 20 mSec

Field Resistance

7 to 18 Ohms.

Analog Input

Maximum Input : ± 5Vdc
Sensitivity : 1 Volt for 2 % generator Volts

External Volts Adjustment

Atleast ± 10 % with 100 K Ohms 1 Watt trimmer

Droop Input

Burden : 0.25 Ohms
Maximum Sensitivity : 1 Amp for 10 % Droop
Maximum Input : 2 Amps

Under frequency protection

Factory setting : 47 Hz with Switch 2 OFF
57 Hz with Switch 2 ON
Slope : 100 - 300 % down to 25 Hz

DIP : 1%Hz = 1%Volts to 1%Hz=3%Volts

DWELL : Adjustable from 0 to 45 V in 4 Sec Max.

Environment

Operating Temperature : -40 to +70 °C
Storage Temperature : -40 to +90 °C
Relative Humidity : Max. 95%
Vibration : 3.3Gs @ 100-2K Hz

Dimension and Weight

175 mm L x 129 mm W x 37.5 mm H
XXXX

AVR CONTROL FUNCTION

CONTROL:	FUNCTION:	DIRECTION:
VOLT	To adjust generator output voltage	Clockwise increases output voltage
STAB	To prevent voltage hunting	Clockwise increase in response
UFRO	To set under frequency Roll Off knee point	Clockwise increases knee point frequency
TRIM	To match AVR input to Accessory Input	Clockwise increases AVR sensitivity
DROOP	To set voltage Droop to 10% at 0.8 PF	Clockwise increases the Droop
EXC TRIP	To set the over-excitation protection Trip level	Clockwise increases the Trip level
DIP	To adjust frequency related voltage Dip	Clockwise increases the Dip
DWELL	To set the rate of voltage recovery time	Clockwise lengthens the recovery time.
SW1-ON	To add fix response time	SW1-ON : Increase in response time for 60 Hz
SW1-OFF	Response time as per STAB Pot	SW1-OFF : Response time for 50 Hz
SW2-ON	To set UFRO knee point at higher frequency	SW2-ON : UFRO set at higher frequency
SW2-OFF	To set UFRO knee point at lower frequency	SW2-OFF : UFRO set at lower frequency

SAFETY PRECAUTIONS

Before installing, adjusting or using this product it is important that you read the content of this manual and also become familiar with the equipment.
Observe all cautions and warning notices

Caution **Caution refers to a hazard or unsafe method or practice which can result in product damage.**

Warning **Warning refers to a hazard or unsafe method or practice which can result in injury or death.**

* Do not operate the equipment with the protective generator terminal cover removed.
* All work and adjustment must be carried out by skill technician using instruments and equipments which are regularly checked for safety.
* Before carrying out any maintenance work, disable engine system, automatic closure circuit and turn off anti condensation heaters.
* Never expose Live connections unless you have created safe working area around you.

Warning **This AVR has capacitors which have stored charge present even after stopping the generator and can remain charge for upto 5 minutes. Terminal F+, F-, P1, P2 and P3 are linked to this charged capacitor, so do not work on the wiring of AVR or machine until this time has elapsed.**

AVR SETTING

Most of the AVR adjusments are factory set in positions which will give satisfactory performance during installation of generator. But to achieve optimum performance under operating conditions, adjustment of some setting is required and details are as below :-

Warning **During testing it is required to adjust controls which are very near to Live terminals or components. Only personnel qualified to perform Live electrical service should carried out the testing or adjustment.**

Voltage [VOLTS] Adjustment :

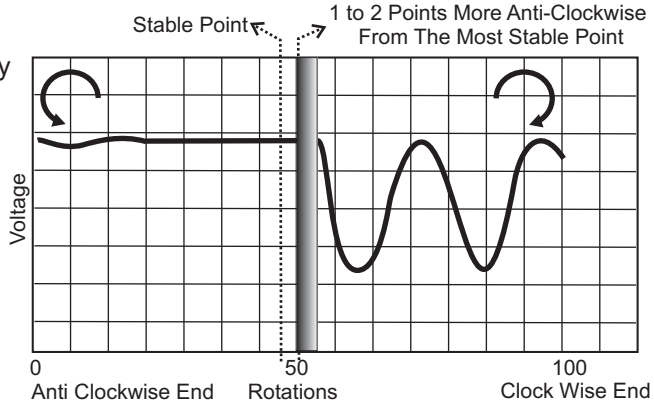
The generator output voltage is set to 400 V at the factory but can be altered by adjusting Volt control or by external trimmer

Caution **Do not increase the voltage above the rated voltage of the generator.**

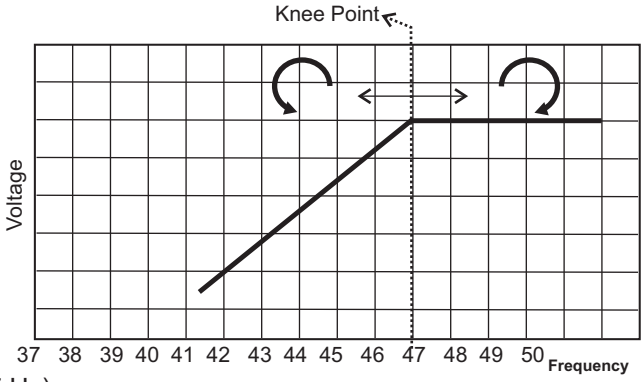
If a replacement AVR has been fitted or voltage setting is not known then proceed as below:-
1. Before running the generator ensure that the suitable voltmeter is available to measure generator output voltage.
2. Turn the VOLTS control fully anti-clockwise and turn the external hand trimmer (if fitted) to its Midway position.
3. Turn the STAB control to its Midway position.
4. Start the generator set, and run at no load condition at nominal frequency e.g. 50 or 60 Hz.
5. If UFRO LED is ON refer to the UFRO setting.
6. If O/L LED is ON refer to the O/L setting.
7. Carefully turn the capital VOLTS controls clockwise until rated voltage is reached.
8. If voltage instability is present refer to STAB adjustment and then re-adjust the generator voltage if necessary.

Stability [STAB] Adjustment :

The AVR Stability circuit ensure good steady state and transient performance of the generator. In addition to STAB adjustment pot, SW1 is also provided to quickly change the response of the stability circuit to suit 50 or 60 Hz application.
The correct setting of the stability control can be achieved as follows:-
1. Before running the generator select appropriate Sw1 position as per the frequency of the generator.
2. Turn the STAB control to its mid-way position.
3. Run the generator at no load.
4. Slowly turn STAB control clockwise until the generator voltage become unstable.
5. Slowly return the STAB control anti-clockwise until the voltage is again stable.
6. Continue to rotate 2 more point anti-clockwise and this is the correct running position.



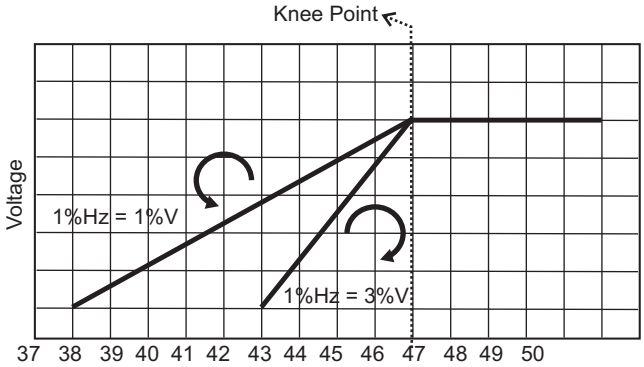
Under Frequency Roll Off [UFRO]



The AVR incorporation an under speed protection circuit for “Volts per Hertz” characteristics when the generator speed falls below an adjustable threshold. Under normal circumstance it would not be necessary to adjust the factory setting of this control, but using SW2, 47 or 57 Hz is quickly adjusted.
To re-adjust the UFRO knee point then proceed as follows:-
(It will be necessary to adjust the generator / engine speed during this procedure)

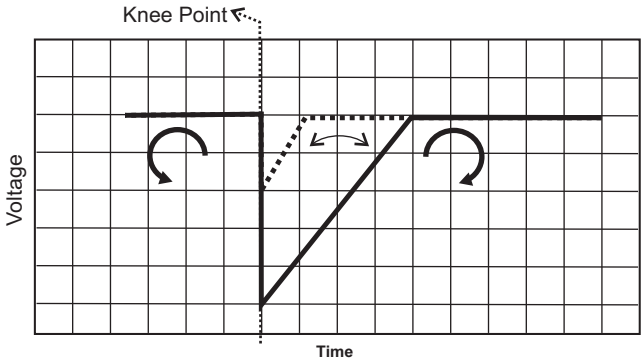
1. Run the generator at no load and at nominal frequency (50 or 60 Hz)
2. Turn the UFRO control fully anti-clockwise (The red led should be OFF)
3. Run the generator at required knee frequency (Typically 47 or 57 Hz)
4. Turn the UFRO clockwise until the led illuminates.
5. Return the UFRO control slowly anti-clockwise until the Led just turn off.
6. UFRO adjustment is now complete.

V/Hz slope [DIP] Adjustment



The DIP adjustment controls the amount of frequency related voltage
dip. This feature is useful when the generator is coupled with the turbo charged engines with limited step load acceptance capability. This features only operate when the speed is below the UFRO knee point and works by increasing the V/Hz slope to give greater voltage dip in the proportion of falling speed. This also reduce KW on the generator and helps recovering the falling speed.
With the DIP control fully anti-clockwise the generator voltage characteristic will follow minimum V/Hz line as the frequency falls below nominal. (1%Hz=1%V)
Turning the DIP clockwise creates a greater slope in the V/Hz Characteristics thus aiding engine speed recovery.

Dwell [DWELL] Adjustment



The dwell function introduces a time delay between the recovery of voltage and recovery of speed. The purpose of the time delay is to reduce the generator KW below the available engine KW during the recovery period, thus allowing the speed recovery. Again this control is only functional below the “knee point”, i.e if the speed stays above the knee point during load switching there is no effect from the DWELL function setting. Thus function is mostly used when the generator coupled to turbo charged engines with limited block load acceptance.
When the DWELL control fully anti-clockwise the generator voltage will follow the V/Hz line as per UFRO setting. Turning the DWELL control increases the delay time between the speed recovery and voltage recovery. The voltage recovery can be held back for several seconds using this switcher.

Droop [DROOP] Adjustment.

Generator intended for parallel operation are fitted with quadrature Droop current (CT) which provides a signal for AVR allowing each generator to share reactive current. The CT is connected to S1 and S2 on the AVR. It is important to match the generator no load voltage to within 1% of each other, to ensure good reactive load sharing. The Droop adjustment is factory set to 0% so that during solo operation there is no voltage drop. With the control fully clockwise is maximum Droop.
For synchronizing, Droop setting procedure is as below:-

1. Run the generator at 50% rated current at any power factor between 0.8 legging and 1.0, ensure that generator rated current value gives a maximum rating for the frame size without any direct factor.
2. Adjust Droop control such that there is voltage drop of around 3 to 3.5% of the no load voltage.
3. Repeat above sets with the second generator also.
4. Now Droop adjustment is complete with both the set and can be synchronized.

Trim [TRIM] Adjustment

An auxiliary input is provided to connect to power factor controller or any other type of PLC controller and is design to accept DC signal upto +/-5 V.

Caution **Any signal connected to this input must be fully floating and earth free.**

The DC signal present to this input adds to or subtracts from the AVR reference circuit input and allows the external controller to alter the generator excitation. The TRIM control allows the user to determine how much control the external signal has over the AVR. With the Trim control fully clockwise the external signal has full control, with the trim control fully anti-clockwise has no control.

Over Excitation [O/L] Adjustment

The AVR includes the protection circuit to remove generator excitation in the event of over excitation, this condition is usually a result of overload and can damage the rotor component within the generator. The excitation is cut of after a delay of 20 seconds. During this time delay the overload condition should be continuous. Clockwise rotation of the O/L control increases the excitation trip level. An over excitation trip condition is indicated by Red LED. The generator must be stopped to reset the overload trip condition.

WIRING

1. **Sensing Input Terminal V0 - V200 - V380** : When the generator output voltage required is 220Vac, connect the sensing input to the terminal V0 and V200. When the generator output voltage requires 400Vac, connect the sensing input terminal V0 and V380.

2. **Excitation Output F+, F- :** Connect Brushless exciter field to terminals F+ and F-, be sure to observe polarity.

3. **Power Input :** AVR power input is on P1, P2 and P3. Input can be 1 Phase or 3 Phase. 3 Phase PMG can be connected directly to P1, P2 and P3. Without PMG, Main Winding can be used as a power input. In that case for 400V system connect U to P1 and N to P2. For 200V system connect U to P1 and W to P2. If auxiliary winding is there, then that can also be used to power the AVR.

4. **Current Compensation Input S1 and S2 :** Current transformer of In:1A is connected to this terminal for parallel operation.

5. **External Voltage Adjustment VR1-VR2 :** If remote adjustment is required then connect a 100K/1W potentiometer to terminal VR1 and VR2. VR1 and VR2 are left unconnected if remote pot not in use

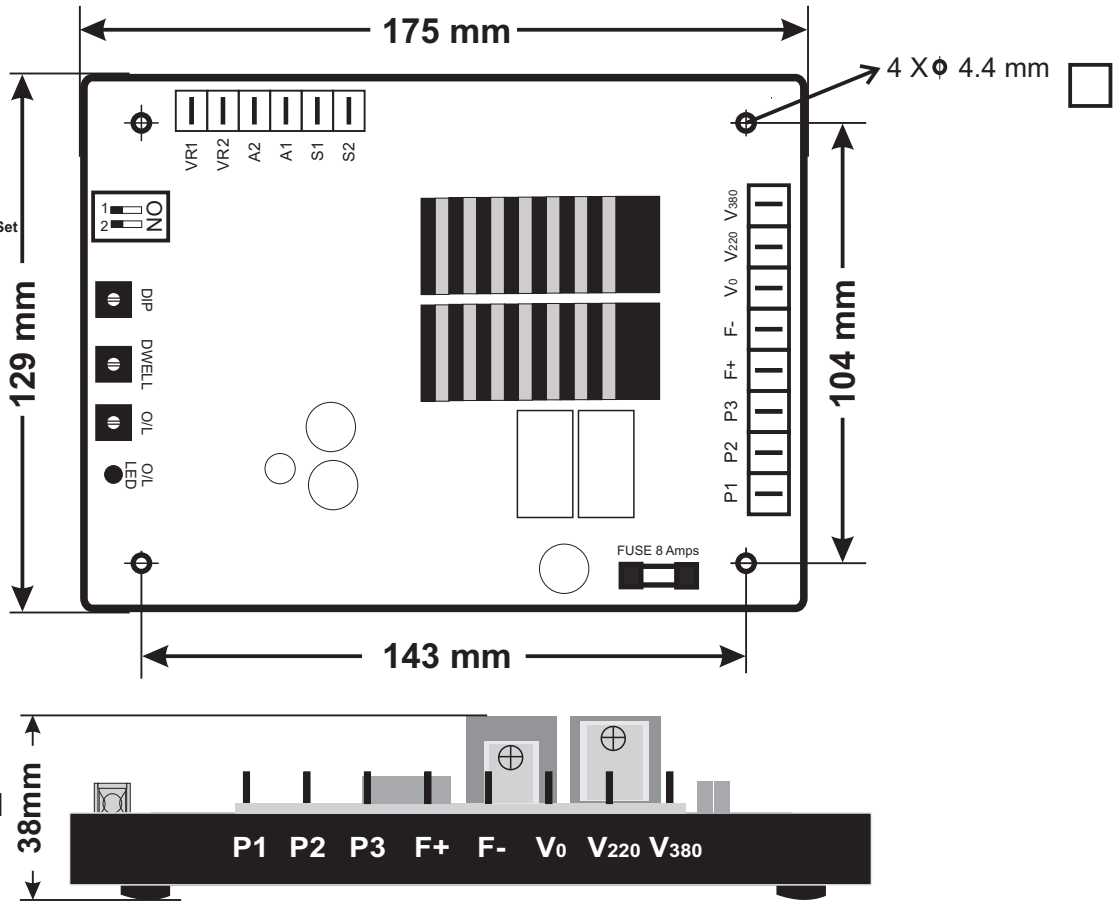
6. **Analog Input A+ and A- :** ± 5Vdc from external controller is connected to A+ and A-

7. **Dip Switch : SW1 - ON :** Increases response time. Can be used for 60 Hz machine to increase the response time (Slow response) or with 220V system when slow response is needed.
   SW1 - OFF : Response as per STAB pot set
   SW2 - ON : 60 Hz
   SW2 - OFF : 50 Hz. As per STAB pot set

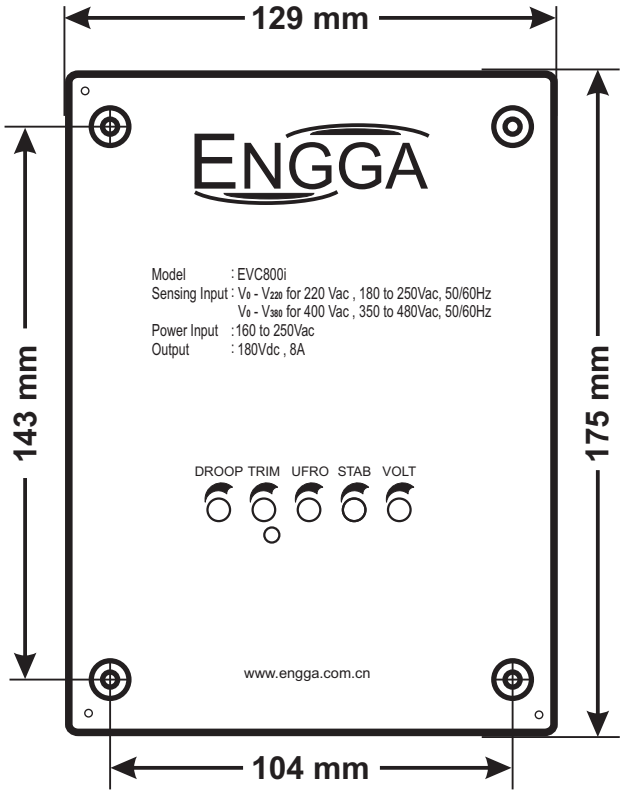
MECHANICAL SPECIFICATION

DRAWING

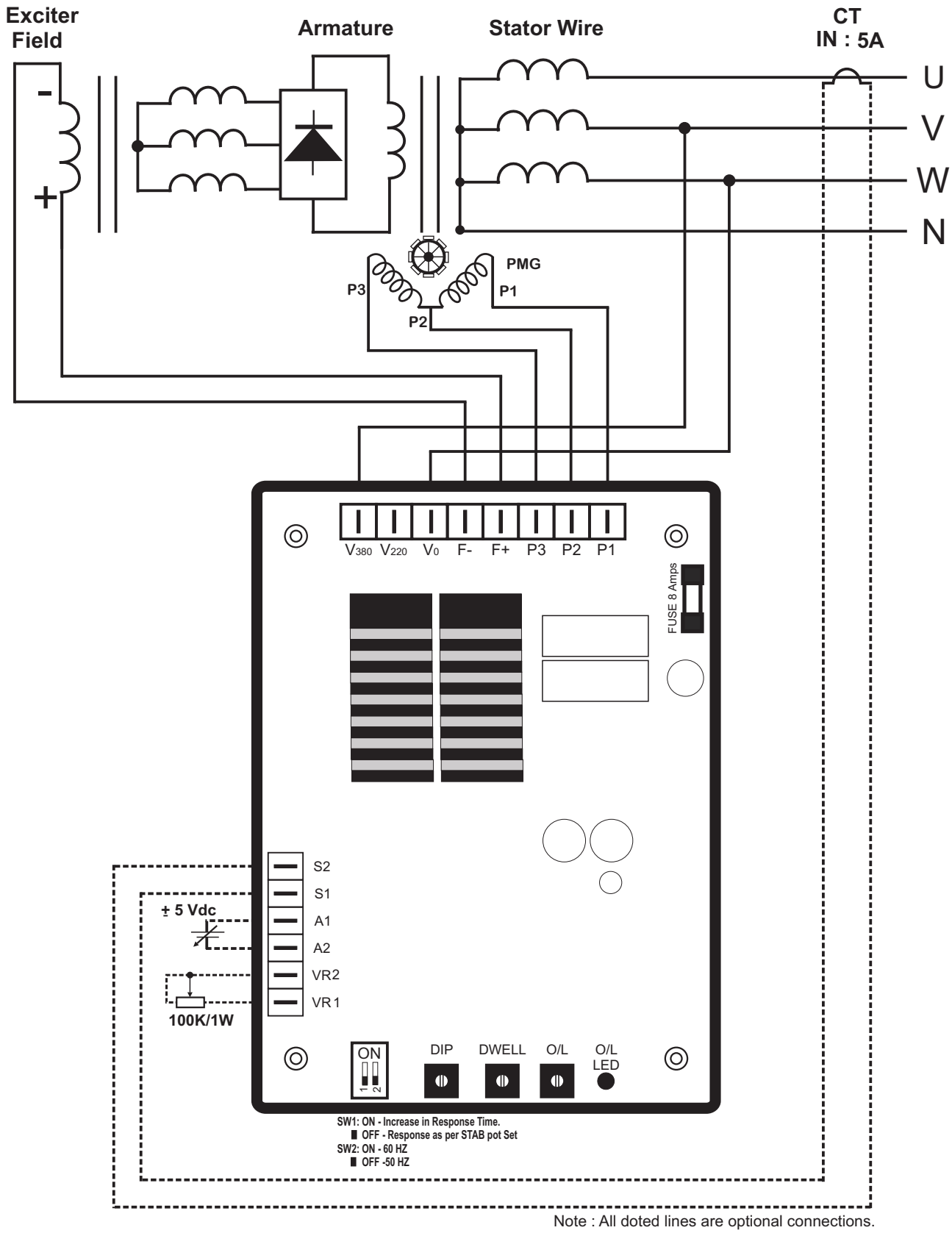
SW1: ON - Increase in Response Time.
OFF - Response as per STAB pot Set
SW2: ON - 60 HZ
OFF -50 HZ



Outline Drawing

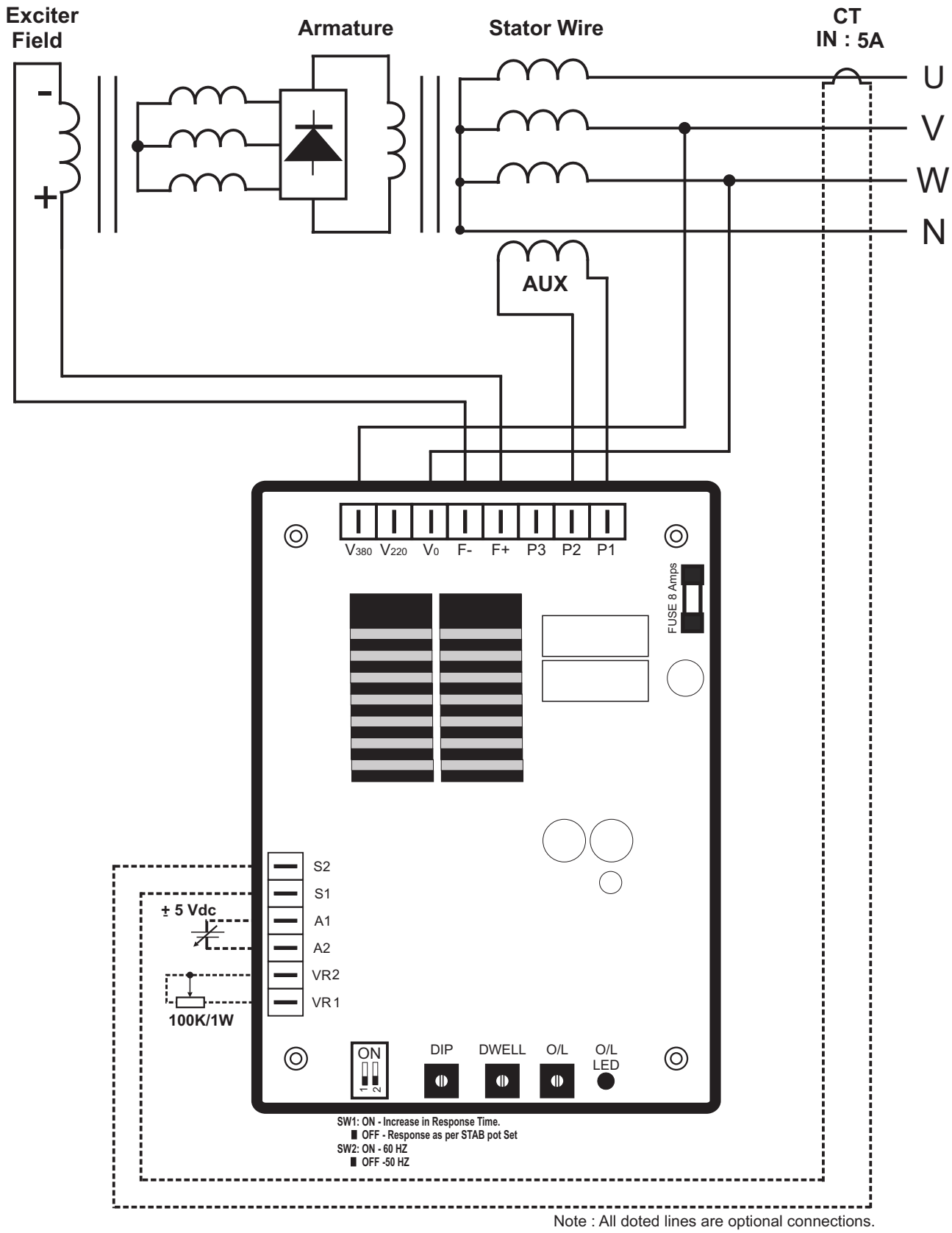


The Drawing For Trimmer



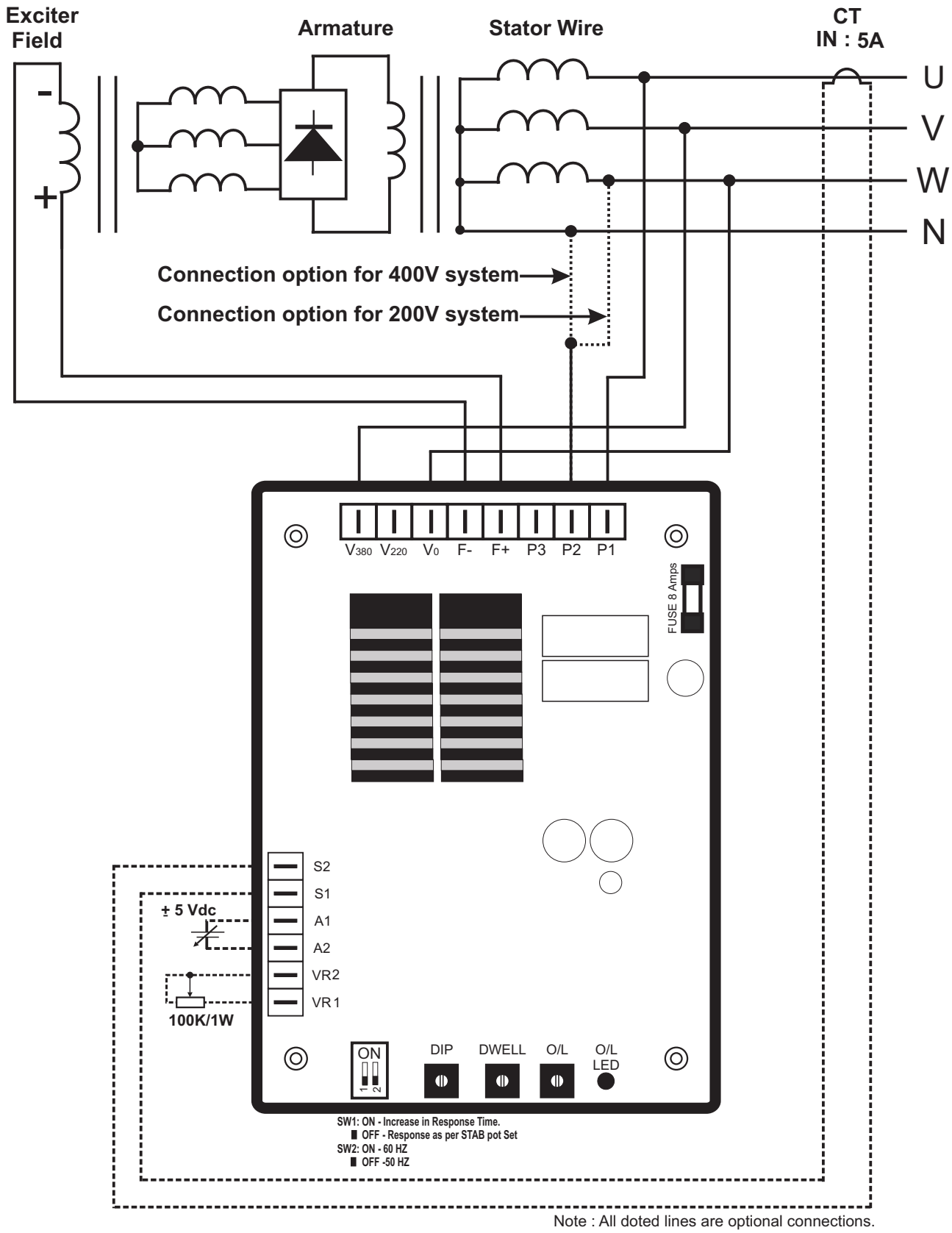
Note : All doted lines are optional connections.

Connection Diagram with PMG Operation



Note : All doted lines are optional connections.

Connection Diagram with Auxiliary Winding



Note : All doted lines are optional connections.

Connection Diagram with Main Winding