

EA200A

Generator Automatic Voltage Regulator Operation Manual



200 Amp Automatic Voltage Regulator
Compatible with Self Excited Carbon Brush Type Generators
Full Wave & Half Wave Version Selectable



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ETC

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SECTION 1 : SPECIFICATION

Sensing Input (S1 、 S2) Average Reading

Voltage	85 to 550 Vac	1 phase 2 wire
Adjustment	85 to 125 Vac @ 110 Vac	
Range	170 to 250 Vac @ 220 Vac	
	300 to 440 Vac @ 380 Vac	
	340 to 510 Vac @ 440 Vac	
	380 to 550 Vac @ 480 Vac	
Frequency	50 / 60 Hz	selectable

Power Input (AC1 、 AC2)

Voltage	160 to 280 Vac	1 phase 2 wire
Frequency	40 to 60 Hz	

Excitation Output (at 220 Vac Input, Half-wave)

Voltage	Continuous 63 Vdc	Max. 90 Vdc
Current	Continuous 200A	Max. 250A 10 Sec.
Resistance	Min. 0.3 ohms	Max. 100 Ohm

Excitation Output (at 220 Vac Input, Full-wave)

Voltage	Continuous 125 Vdc	Max. 180 Vdc
Current	Continuous 200A	Max. 250A 10 Sec.
Resistance	Min. 0.6 ohms	Max. 100 Ohm
Half-wave and Full-wave Selectable		

Controller Power Input (B+ 、 B-)

Voltage	24 Vdc (20 to 28Vdc)
Current	Lesser than 10A
DC Power supply for initial field flashing, excitation current display, alarm protection function.	

External Volts Adjustment (VR1 、 VR2)

Max. +/- 3.5%	@ 1 K Ω 1/2 watt potentiometer
Max. +/- 7%	@ 2 K Ω 1/2 watt potentiometer

Analogue Voltage Input (A1 、 A2)

Input resistance	greater than 2K Ohm
Max. input +/-	5 Vdc or 0 – 10 Vdc
Sensitivity	1 Vdc for 2% (Trim adjustable)

Quadrature Droop Input (C1 、 C2)

CT N:5A	greater than 5VA
Sensitivity +/-	7% @PF +/- 0.5 (Droop adjustable)

Soft Start Ramp Time

3 secs. +/- 10%

Voltage Regulation

Less than +/- 0.5% (with 4% engine governing)

Typical System Response

Less than 20 milliseconds

Static Power Dissipation

Max. 40 watts

Under Frequency Protection (Knee point factory preset)

50 Hz system presets knee point at 45 Hz
60 Hz system presets knee point at 55 Hz

Environment

Operating Temperature	40 – +60 °C
Storage Temperature	-40 – +85 °C
Relative Humidity	Max. 95%

Dimensions

600.0 (L) x 305.0 (W) x 860.0 (H) mm
23.62 (L) x 12.01 (W) x 33.86 (H) inch

Weight

67 Kg +/- 2%
147.7 lb +/- 2%

ATTENTION

- ※ Disconnect AVR wiring before using high resistance meter or withstand voltage tester, to avoid the AVR damaged by high voltage.
- ※ Make sure you have read and understand the contents of the instruction manual prior to installation. Incorrect wiring connection may result in irreversible damage to the product and other equipment.
- ※ This Automatic Voltage Regulator is not equipped with loss-Sensing Protection function / Over Excitation Protection. An additional Over-Voltage Protection device for load may be required to avoid possible damage to the equipment or severe personal injury or death.
- ※ All AC voltage readings are average value only.

SECTION 2 : OUTLINE DRAWING

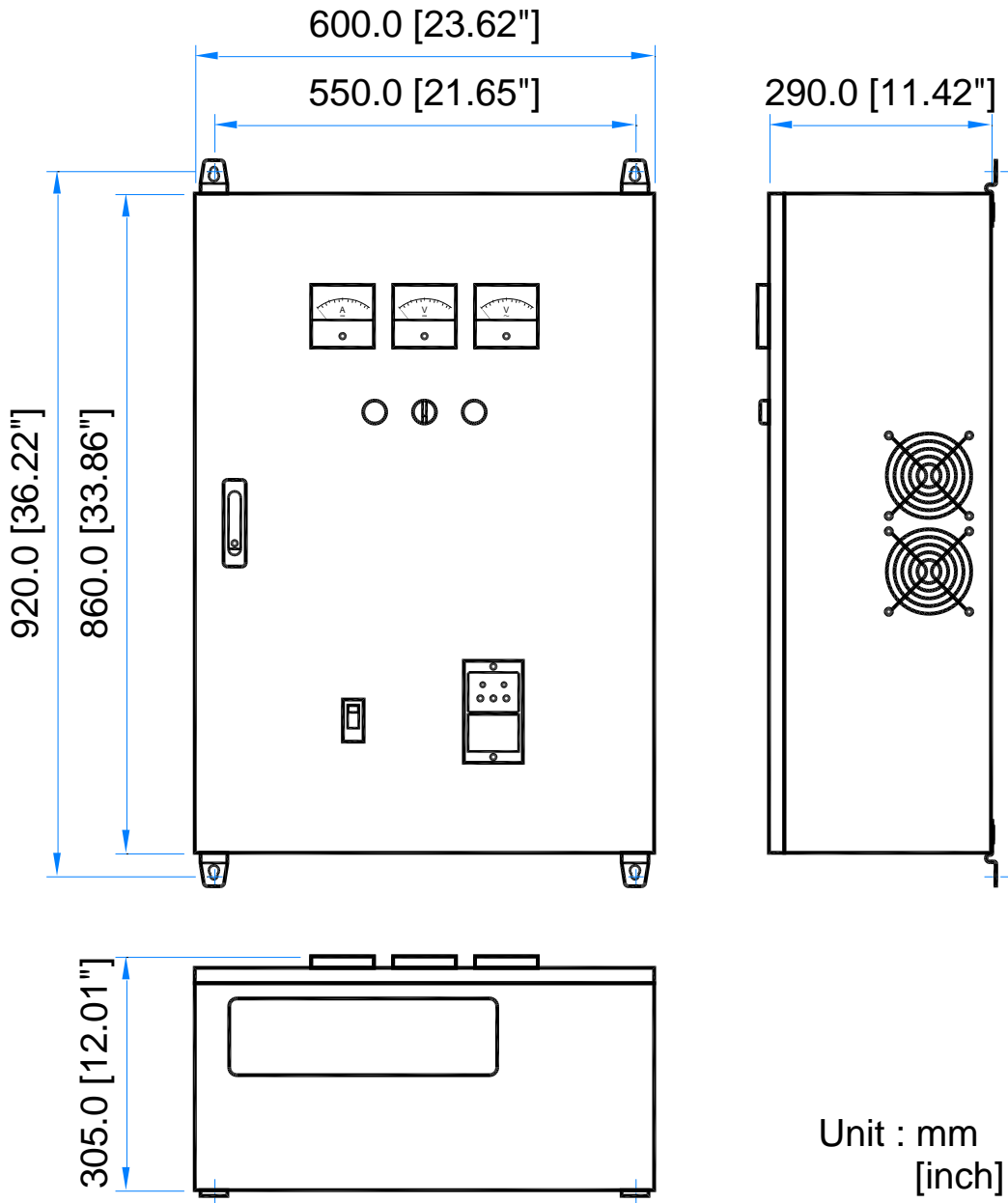


Figure 1. Outline Drawing

ATTENTION

- ※ The unit must be installed/ repaired by qualified technician.
- ※ AVR could be installed in any suitable locations of the generator sets, the appearance and fixing holes are as (Figure 1), avoid high temperature, moisture, and location where AVR cannot be easily reached.
- ※ AVR heat sink may reach a high temperature (above 60 °C) when AVR is powered, do not touch or ground AVR heat sink.

SECTION 3 : INTERNAL SPECIFICATION

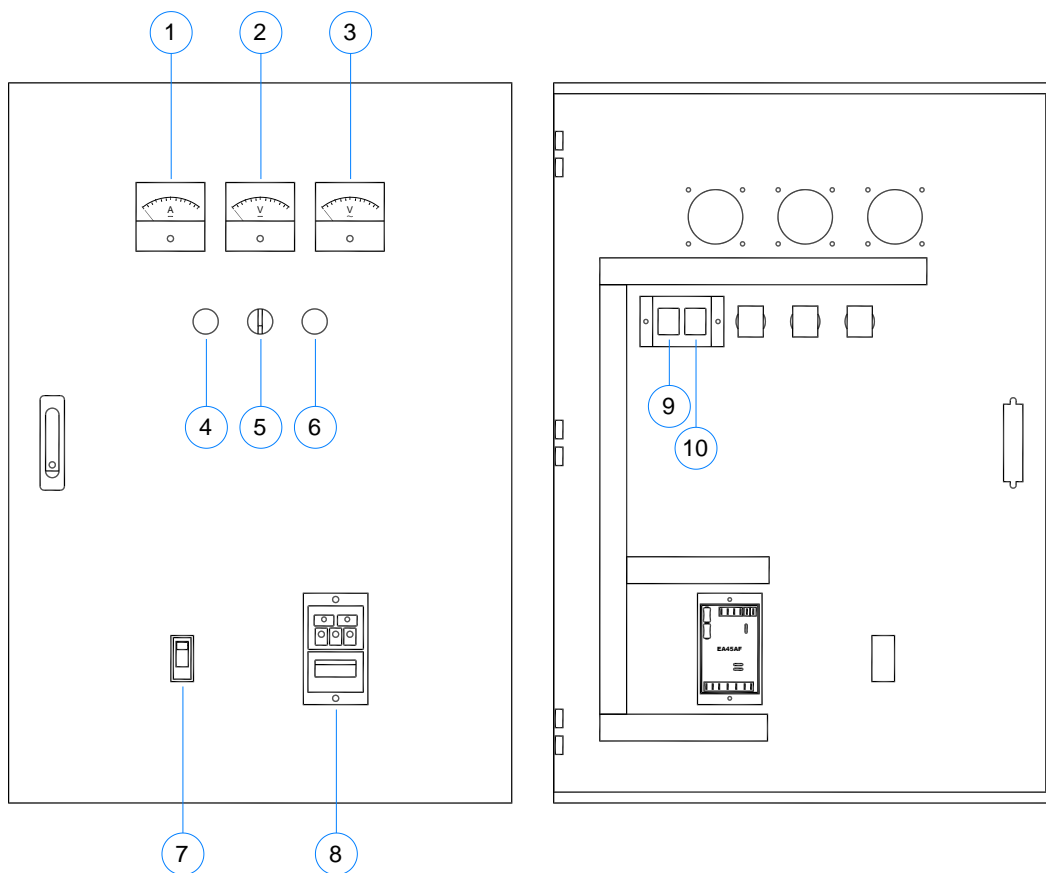


Figure 2.

Item	Description / Function
1	Field current meter
2	Field voltage meter
3	Generator voltage meter (Sensing voltage)
4	Over temperature alarm indicator
5	Auto / Manual Field Flash selector
6	Over temperature shutdown indicator
7	Power input MCCB
8	EA45AF-2 Control Module
9	50 Hz / 60Hz Frequency Selector
10	Half Wave / Full Wave selector

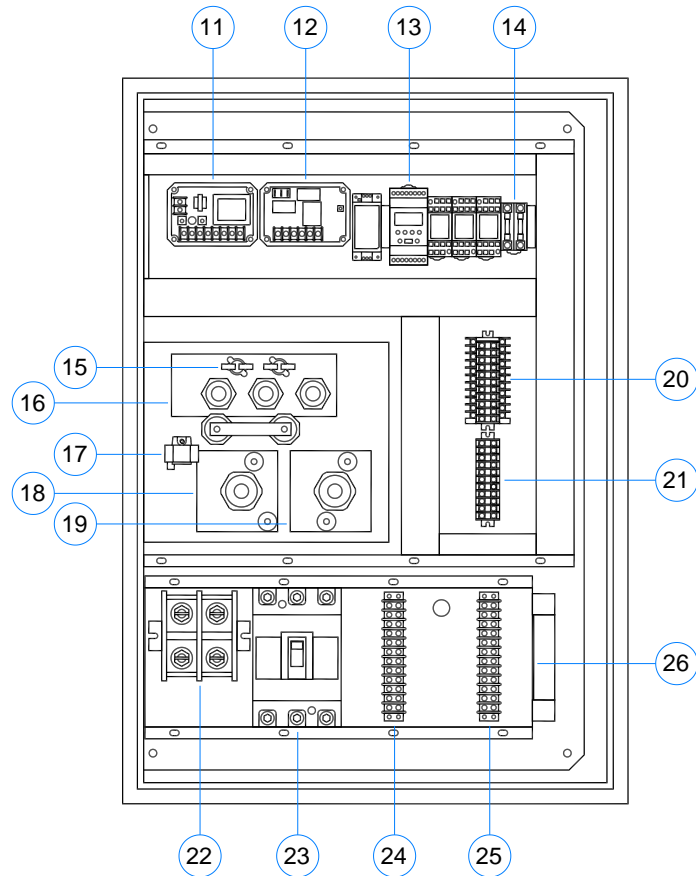


Figure 3

Item	Description / Function
11	EA45C Parallel Module
12	EB500 Automatic Flashing Module
13	EP4-1 DC Voltage Protection Module
14	10A DC Power Protection Fuse
15	Temperature switch
16	Rectifier Diode D1, D2, D3 and Heatsink
17	Hall Effect-Based Current Sensor
18	SCR 2 and Heatsink
19	SCR 1 and Heatsink
20	Terminal TB4 (for internal wiring)
21	Terminal TB5 (for sensing voltage and voltage selector for Fan)
22	Terminal TB1 (for Excitation output)
23	Power input MCCB
24	Terminal TB2
25	Terminal TB3
26	Sensing voltage / Fan Power Transformer (under the iron frame)

SECTION 4 : TERMINAL CONNECTION

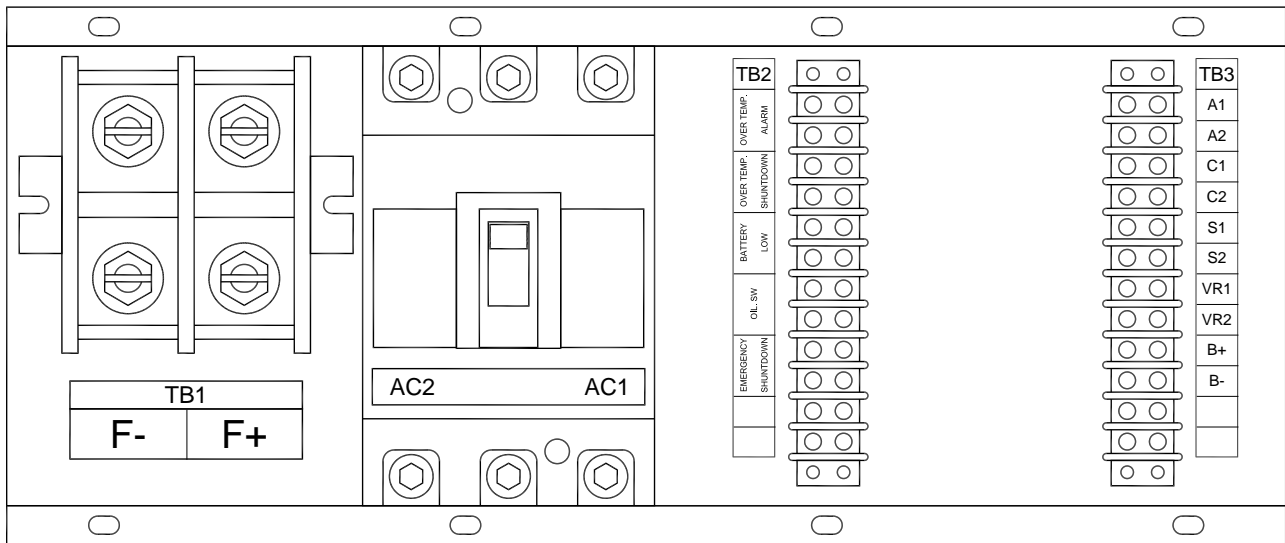


Figure 4

4.1 Excitation field output Terminal

TB1	
F+ 、 F-	Connect Excitation Field + and - The recommended wire diameter is 60mm ² or 00(2/0)AWG or greater

4.2 Power input Terminal

NFB	
AC1 、 AC2	Connect Power Input The recommended wire diameter is 60mm ² or 00(2/0)AWG or greater

4.3 TB2 Signal Input / Output Terminal

TB2	
OVER TEMP. ALARM	Over Temp. Pre-Alarm Output Contact (Max. 2A @ 250 Vac) Contact CLOSED when Temp. is over 100°C ; Contact OPENED when Temp. is below 90°C (Refer to Section 7)
OVER TEMP SHUTDOWN	Over Temp. Shutdown Contact (Max. 2A @ 250 Vac) Contact CLOSED when Temp. is over 130°C ; Contact OPENED when Temp. is below 120°C (Refer to Section 7)
BATTERY ABNORMAL	Battery Voltage Abnormal Alarm Contact (Max. 2A @ 250 Vac) Contact CLOSED when Battery voltage is below 20V or over 28V
OIL SW	Oil Pressure Switch for Automatic Flashing Unit (Refer to Section 6)
EMERGENCY SHUTDOWN	External Emergency Stop Switch to Stop Power Output to Generation OPEN : Normal Operation, CLOSE : STOP Power Output to Generation (Refer to Section 8)

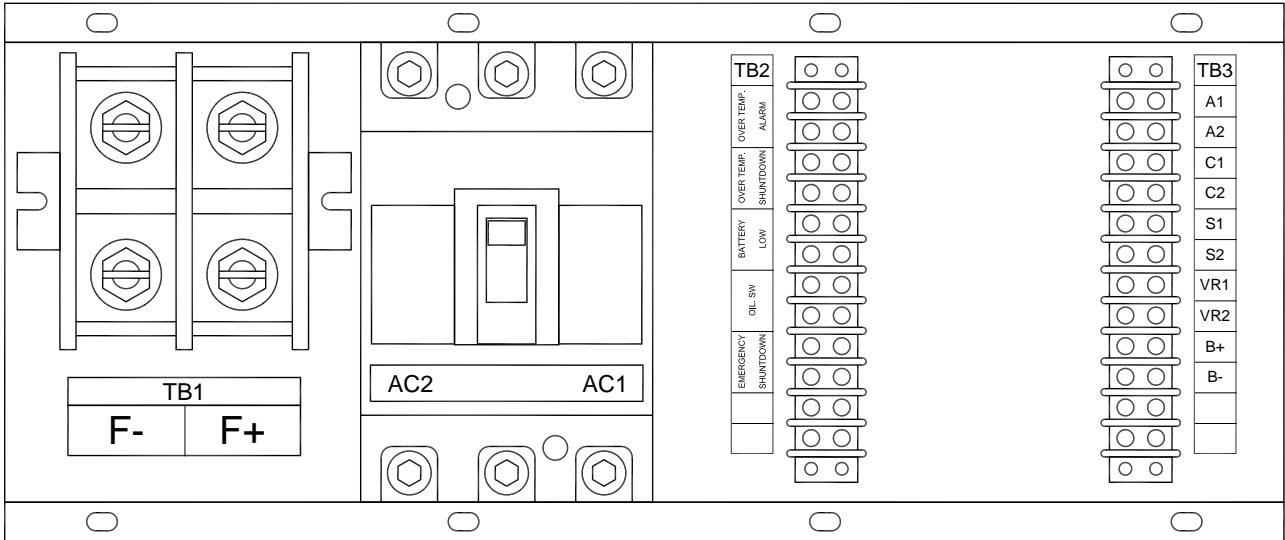


Figure 5

4.4 TB3 Signal Input / Output Terminal

TB3	
A1 ∙ A2	Parallel Controller Analog Voltage Input (0 to 10Vdc or +/-5Vdc) A1 is GND
C1 ∙ C2	CT Input (N:5A 5VA)
S1 ∙ S2	Sensing Input
VR1 ∙ VR2	External Voltage adjust potentiometer (1KΩ 1/2W) Must be shorted when not in used.
B+ ∙ B-	DC24V Power input

ATTENTION

- ※ This Automatic Voltage Regulator is not equipped with loss-Sensing Protection / Over Excitation Protection. An additional Over-Voltage Protection device for load may be required to avoid possible damage to the equipment or severe personal injury or death.
- ※ The connection wire for VR1, VR2 and A1, A2 must be shielded wire, the grounding wire of shielded wire should be as close as possible to the AVR.
- ※ The A1 and A2 signal must be isolated from the power.
- ※ All the power of EA200A protection system were supplied by 24Vdc, the B+ and B- terminal must be connected correctly, otherwise all the protection, Self-Excited, and the Field Current meter cannot be used.

SECTION 5 : SETTING AND ADJUSTMENT BEFORE START

5.1 Select and set sensing input voltage and Fan voltage

Example :

220V Output Voltage:

S1 & S2 connect to R-T (220V)

MCCB AC1 & AC2 connect to R-T (220V)

FAN VOLT: Cross connect COM1 & 220V

SENSING VOLT: Cross connect COM2 & 220V

400V Output Voltage :

S1 & S2 connect to R-T (400V)

MCCB AC1 & AC2 connect to S-N (230V)

FAN VOLT: Cross connect COM1 & 220V (select the closest voltage 230V)

SENSING VOLT: Cross connect COM2 & 380V (select the closest to 400V)

440V Output Voltage :

S1 & S2 connect to R-T (440V)

MCCB AC1 & AC2 connect to S-N (254V)

FAN VOLT: Cross connect COM1 & 245V (select the closest voltage 254V)

SENSING VOLT: Cross connect COM2 & 440V

480V Output Voltage :

S1 & S2 connect to R-T (480V)

MCCB AC1 & AC2 connect to AUX Power (180V)

FAN VOLT: Cross connect COM1 & 190V (select the most close voltage 180V)

SENSING VOLT: Cross connect COM2 & 480V

※ **FAN VOLT must be selected to the closest voltage on MCCB AC1 & AC2**

※ **SENSING VOLT must be selected to the closest voltage on S1 & S2**

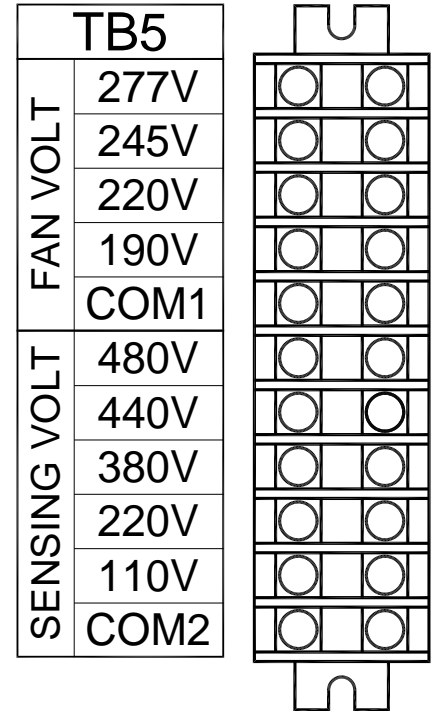


Figure 6

ATTENTION

※ **The factory preset FAN VOLT is 277Vac, SENSING VOLT factory preset is 110Vac. Make adjustment before operation on the first time installation.**

5.2 EA45AF Adjustment

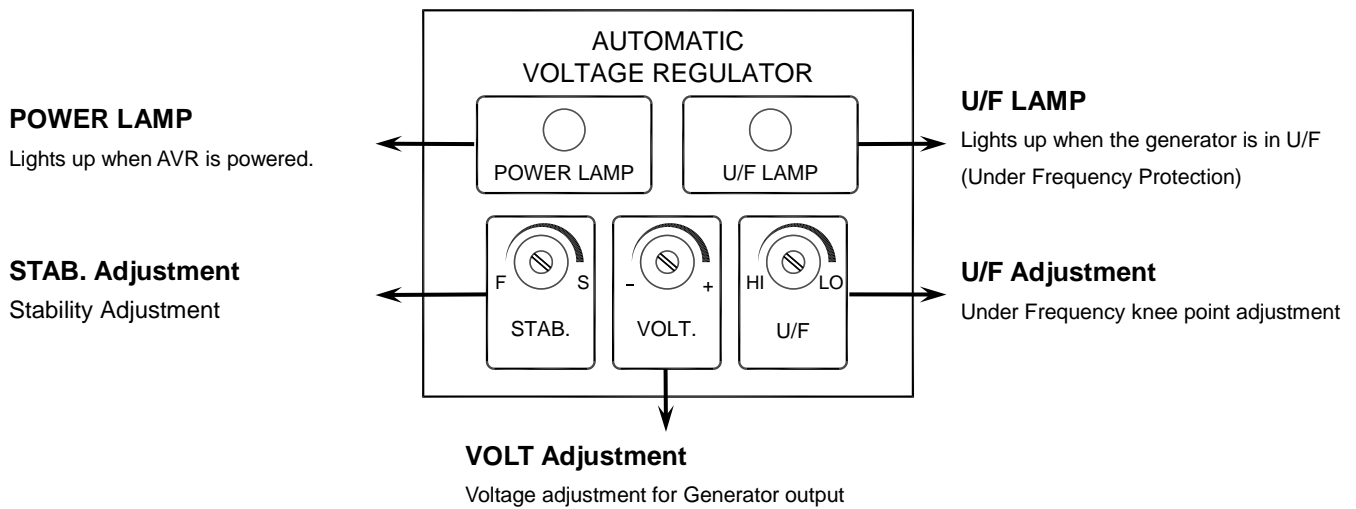


Figure. 7

5.2.1 Stability Adjustment

Look at the DC field voltmeter on the panel. When there is no load, turn the STAB knob counterclockwise until the pointer of the field voltmeter swinging. And then, adjust the STAB knob clockwise until the swinging field voltmeter pointer is just stable, then turn it clockwise a bit more (5~10 degree).

5.2.2 Under Frequency Adjustment

Note : Under Frequency protection factory preset 45/55Hz.

Follow below steps to adjust the setting when necessary.

- i. Set frequency selector to required frequency setting
(50Hz U/F adjustable range : 40~50Hz)
(60Hz U/F adjustable range : 50~60Hz)
- ii. Start the Generator, then adjust the generator frequency to the desired knee point frequency
- iii. Turn the U/F knob clockwise until the U/F LAMP light is off.
- iv. Adjust the U/F knob counterclockwise until U/F LAMP just lights up (or flashing).
- v. Adjust the generator frequency to normal speed.

ATTENTION

- ※ Improper setting of under-frequency protection could cause the output voltage of the unit to drop or become unstable under with changes in load. Avoid making any changes to the U/F setting unless necessary.

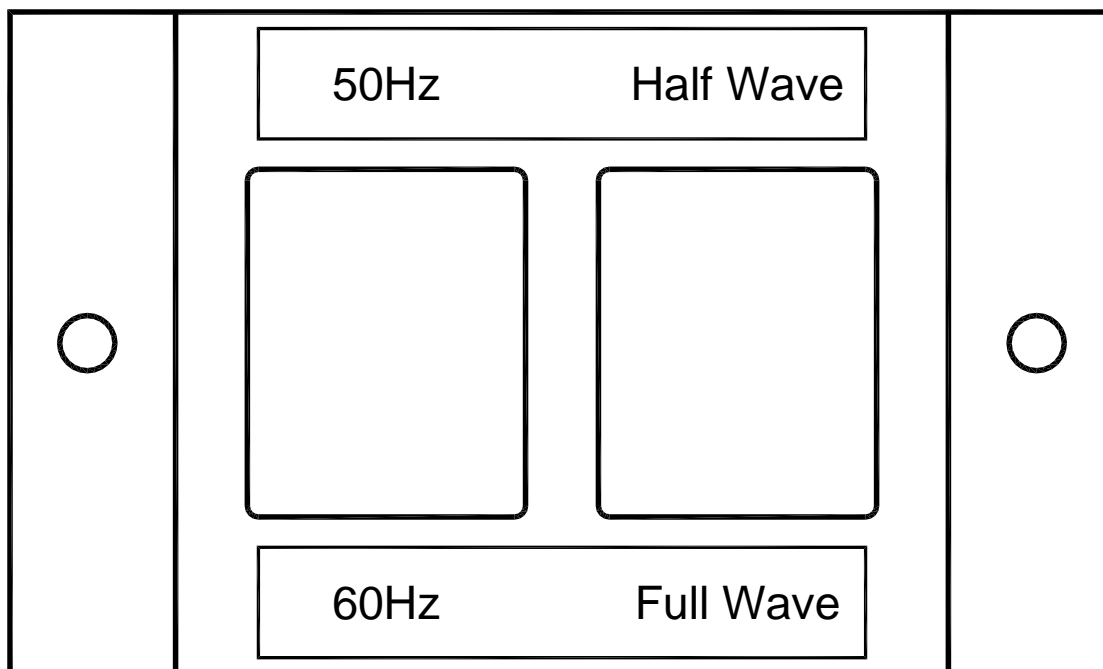


Figure. 8

5.2.3 Generator Frequency Selector

Select Generator frequency for U/F protection (Factory preset 60Hz)

50 Hz system factory presets knee point at 45 Hz

60 Hz system factory presets knee point at 55 Hz

5.2.4 Half Wave / Full Wave Selector

Select half wave or full wave output according to Generator excitation voltage in full load (Factory preset Half Wave).

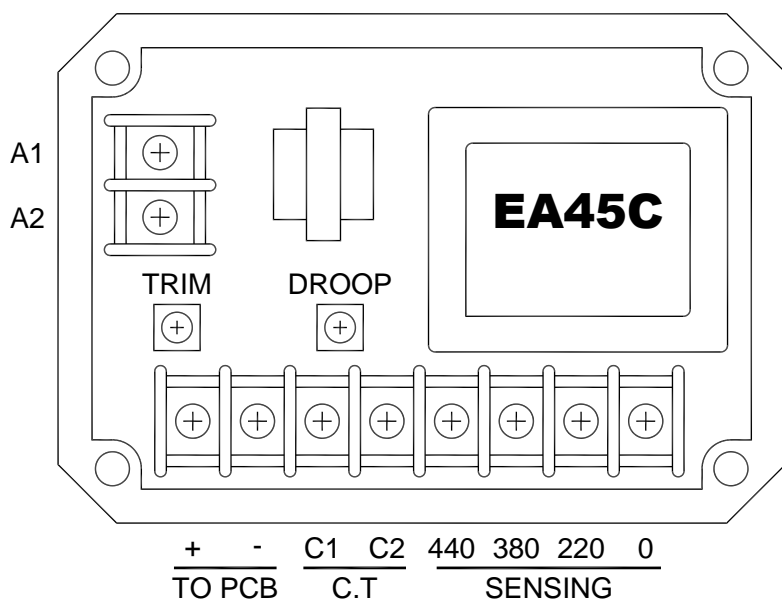
If generator excitation voltage is greater than 60Vdc in Full load, must select Full Wave output.

If generator excitation voltage is less than 30Vdc, must select Half Wave output.

ATTENTION

※ Do not change the Under Frequency setting or Half Wave / Full Wave setting when generator is running.

5.3 EA45C



EA45C Terminals	
SENSING	Sensing Voltage Input
C.T	CT N : 5A
TO PCB	Connect to EA45AF-2
A1 · A2	Analog Voltage Input 0 to +/- 5 Vdc
EA45C Adjustment (adjust according to the situation)	
DROOP	Quadrature Droop compensation Adjustment
TRIM	Analogue voltage compensation adjustment

Figure. 9

EA45C is a Parallel Module. The Droop and Trim must be adjusted when in used for parallel operation, factory preset is counterclockwise to the end.

DROOP : Adjust the quadrature droop ratio of C1, C2 current compensation input value to generator output voltage. When CT and AVR sense that the output voltage and current of the generator are out of sync (leading or lagging), the AVR will increase (lead) or decrease (lag) the generator voltage. Droop was used to adjust the influence ratio of CT input current to the generator voltage. Turn counterclockwise to the end is 0%, and clockwise to the end is +/-7% (Max.).

TRIM : Adjust the influence ratio of the analog voltage input value of A1 and A2 to the generator voltage. When the system provides DC voltage to terminals A1 and A2, the higher the DC voltage, the higher the generator voltage, and vice versa. The TRIM knob is used to adjust the influence ratio of the DC input voltage to the generator voltage, the counterclockwise to the end is 0, and clockwise to the end is +/-10% (Max.).

ATTENTION

※ The A1 and A2 signal must be isolated from the power.

SECTION 6 : FIELD FLASHING

6.1 Automatic Field Flashing

EA200A built-in with EB500 Auto Flash Module. When Generator residual voltage is lower than Build Up Voltage, the EA200A will automatically supply 24Vdc to Magnetic field then establishes AC voltage by following below setting.

- i. Set the FLASH switch to AUTO position
- ii. Connect the OIL SW on TB2 terminal by following one of below three wiring
- iii. Starting generator, the EA200A will automatically establish voltage

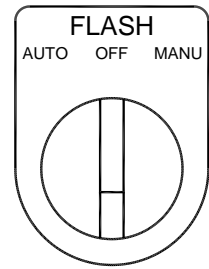


Figure 12.

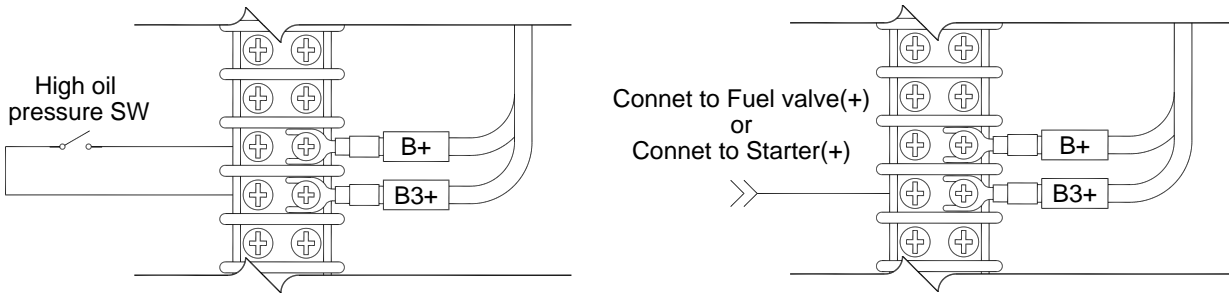


Figure 13

6.2 Manual Field Flashing

Simply switch the FLASH switch to MANU position if Generator needs Manual field flashing. The switch will bounce back to OFF position automatically when it is released

ATTENTION

- ※ EB500 terminal B- cannot be grounded when Generator Neutral is grounded, which may damage the application.
- ※ Automatic / Manual excitation current, please refer to chapter 5.4 for adjustment.
- ※ FIELD Switch factory preset is at OFF position.

SECTION 7 : OVER TEMPERATURE PROTECTION

EA200A built-in with two-stage temperature protection. When the heat sink temperature is higher than 100°C, the overheat alarm contact for OVER TEMP. ALARM will be closed, and the overheat alarm indicator on the panel will light up; when the heat sink temperature drops to 90°C and below, the overheat alarm contact and alarm indicator will automatically reset.

When the heat sink temperature is higher than 130°C, the field output will be forcibly stopped, and the overheating shutdown contact for OVER TEMP. SHUTDOWN will be closed and the overheating shutdown indicator on the panel will light up; When the heat sink temperature is below 120°C, the shutdown contact and indicator will automatically reset.

SECTION 8 : EXTERNAL EMERGENCY STOP POWER GENERATION

EA200A built-in with external emergency stop function, when EMERGENCY SHUTDOWN terminal is shorted, the AVR will terminated excitation field output. Until the EMERGENCY SHUTDOWN terminal is opened, the AVR will resume output to field.

ATTENTION

- ※ All the power of EA200A protection system were supplied by 24Vdc, the B+ and B- terminal must be connected correctly, otherwise all the protection, Self-Excited, and the Field Current meter cannot be used.

SECTION 9 : WIRING DIAGRAM

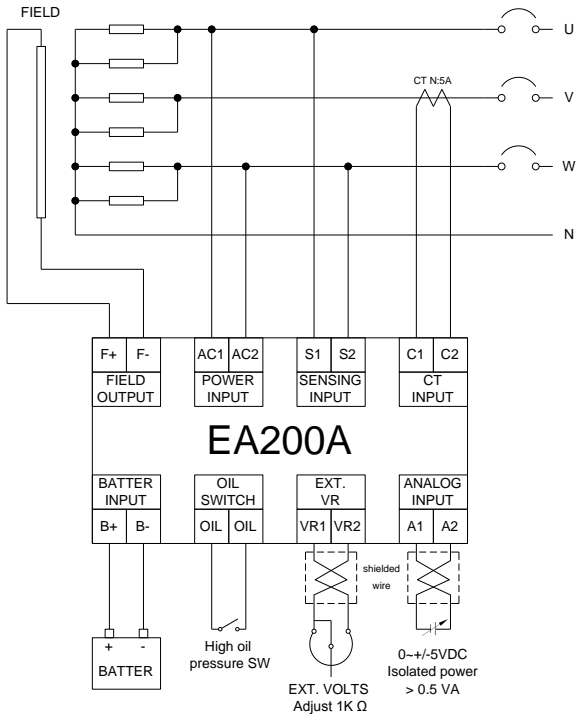


Figure 14 220 Vac

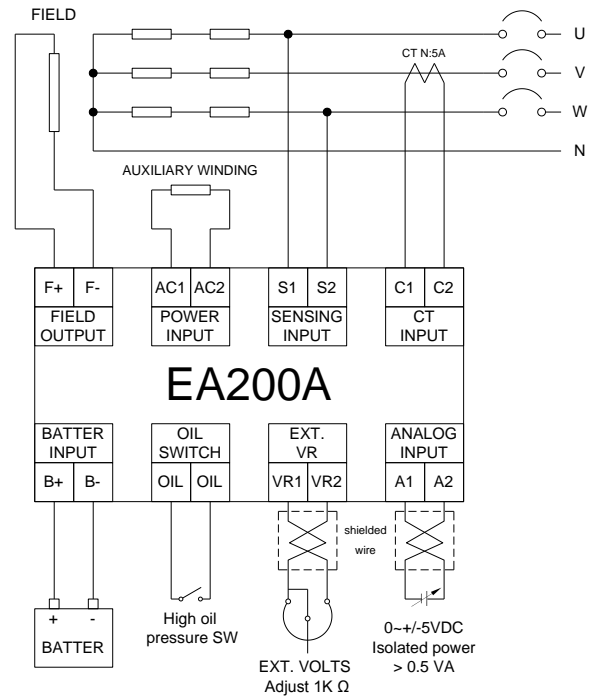


Figure 15 AUX Winding

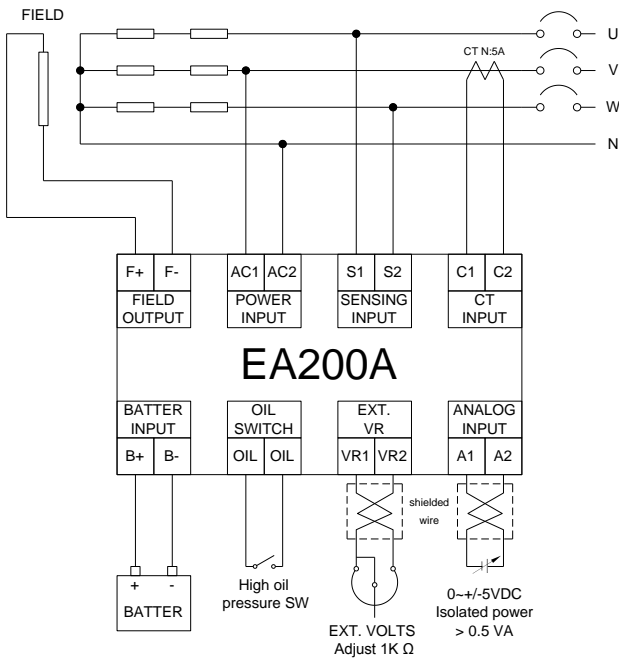


Figure 16 380/440/480 Vac (N Phase)

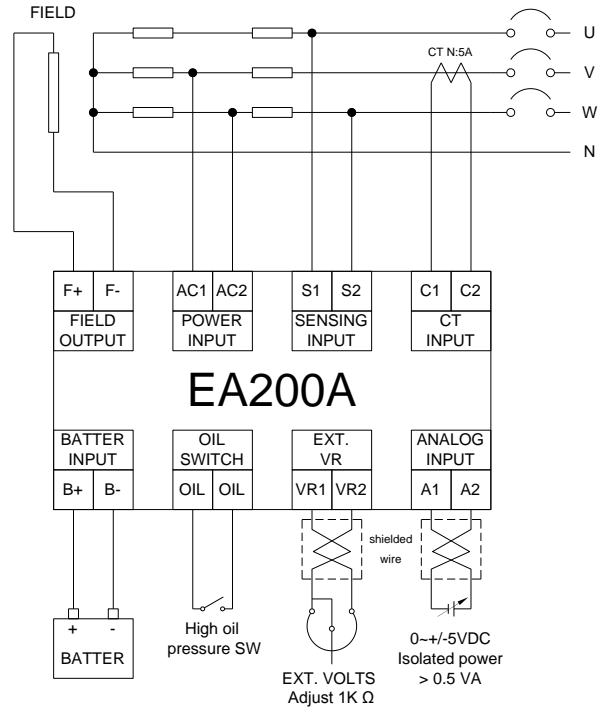


Figure 17 380/440/480 Vac (YY connection)

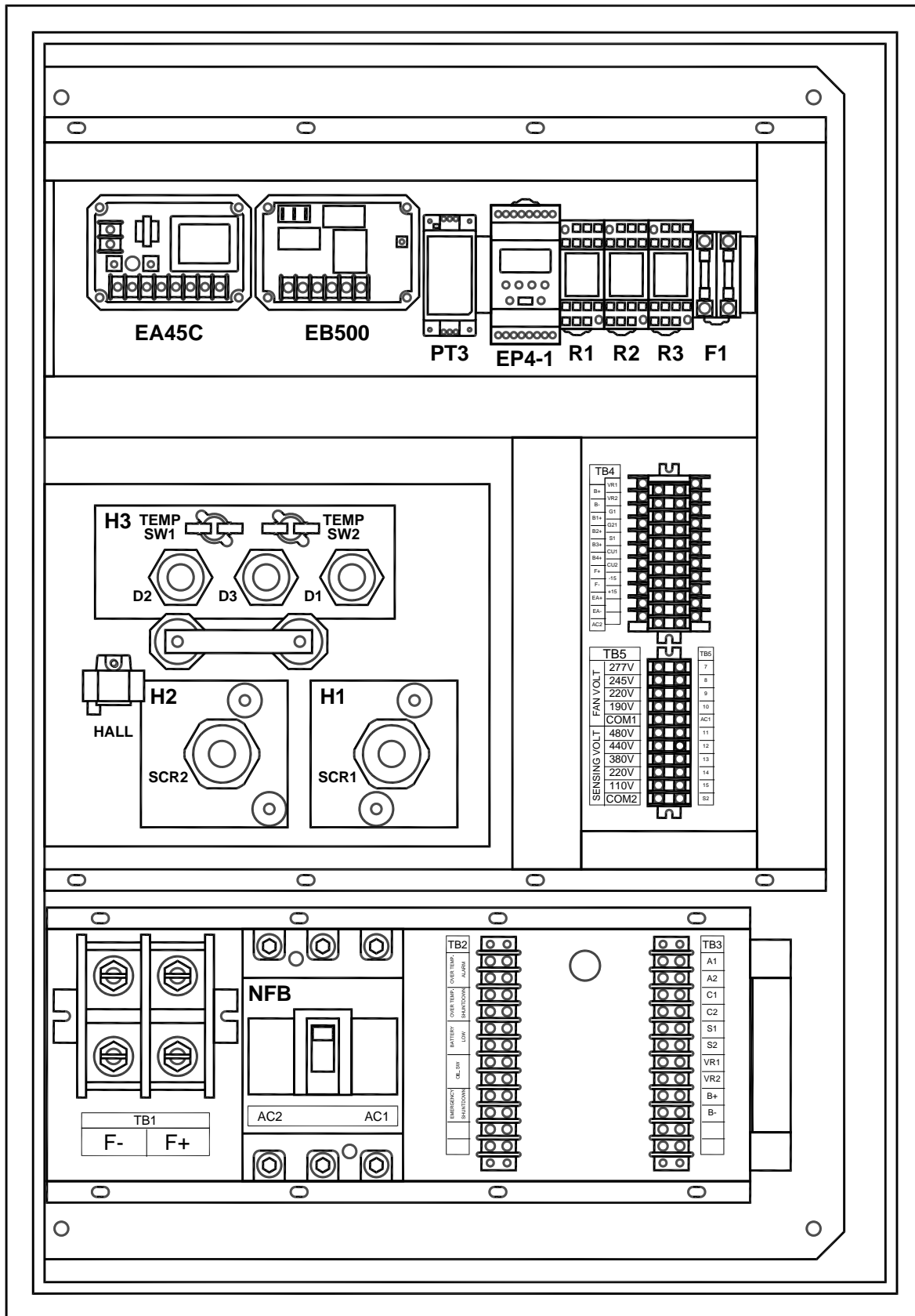
SECTION 10 : TROUBLE SHOOTING

SYMPTOM	POSSIBLE CAUSES	SOLUTIONS
Voltage cannot build up	Residual voltage below 5 Vac	1) Check if B+ and B- have 24Vdc power input 2) Check whether the wiring of the oil pressure switch is normal 3) Check whether the FLASH switch is at correct position 4) Set FLASH switch to Manual excitation to build up the voltage
	F+ and F- reverse connection	Interchange the wiring of F+ and F-
	Engine under speed	Increase engine speed to above 25 Hz
	Carbon brushes were worn out	Replace with new carbon brushes
	AVR heat sink is over temperature	1) Make sure the installation environment has good ventilation 2) Check whether the fan operates normally (when generator is running and output voltage is normal)
External emergency stop terminals closed	Open external emergency stop terminals	
Voltage output is too low	Incorrect voltage selection for sensing power transformer	Select the correct voltage setting for sensing power transformer
	Under Frequency Protection is activated	Select the correct system frequency or increase the generator frequency to the rated speed
	Voltage set point of EA45AF is too low	Adjust the VOLT knob clockwise to make the voltage reach rated value
	External voltage adjustment set point is too low	Adjust the external voltage knob to middle position
	The external voltage adjustment knob is abnormal	Replace the external voltage adjustment knob.
	Incorrect setting for Half Wave / Full Wave output.	Select the correct output voltage (Full Wave must be selected when excitation voltage in full-load is greater than 60Vdc)
	AVR heat sink is over temperature	1) Make sure the installation environment has good ventilation 2) Check whether the fan operates normally (when it can generate power normally)
	External emergency stop terminals closed	Open External emergency stop terminals
Voltage output is too high	Incorrect voltage selection for sensing power transformer	Select the correct voltage setting for sensing power transformer
	Voltage set point of EA45AF is too high	Adjust the VOLT knob counterclockwise to make the voltage reach rated value
Voltage output is unstable (Hunting)	Stability set point is not match Generator properly	Please refer to chapter 5.2.1 for Stability adjustment
	Under Frequency Protection is activated	The setting value of Under Frequency Protection is too close to the knee point. Please refer to chapter 5.2.2 for Under Frequency adjustment
	Incorrect setting for Half Wave / Full Wave output.	Select the correct output voltage (Half Wave must be selected when excitation voltage in full-load is lower than 30Vdc)
	Field resistance or field voltage is too low. (Excitation voltage is lower than 5Vdc when No-load)	Connect suitable resistor in series to increase total resistance
Cooling Fan is no action	Incorrect voltage selection on FAN VOLT transformer	Select correct Fan voltage on FAN VOLT transformer
	The fan is stuck	Clean or replace the fan

※ Appearance and specifications of products are subject to change for improvement without prior notice.

SECTION 11 : APPENDIX

11.1 EA200A Internal drawing



11.2 EP4-1 Operation manual



EP4-1

DIGITAL VOLTAGE PROTECTIVE RELAY

User's Manual

RESTRICTIONS ON USE

When using this product in applications that require particular safety or when using this product in important facilities, please pay attention to the safety of the overall system and equipment. Install fail-safe mechanisms, perform redundancy checks and periodic inspections and adopt other appropriate safety measures when it is necessary. This product is rated at Class II □.

SAFETY PRECAUTION

This manual uses the following symbols to ensure safe operation of this product.

- WARNING** Warnings are indicated when mishandling this product might result in death or serious injury to user.
- CAUTION** Cautions are indicated when mishandling this product might result in minor injury to the user, or only physical damage to the timer.

WARNING

- Note this incorrect wiring of this product can damage it and lead to other hazards. Make sure the product has been correctly wired before turning the power ON.
- Before wiring, or removing / mounting the product, be sure to turn the power OFF. Failure to do so might cause electric shock.
- Do not touch electrically charged parts such as the power terminals. Doing so might cause electric shock.
- Do not disassemble the product. Doing so might cause electric shock or faulty operation.

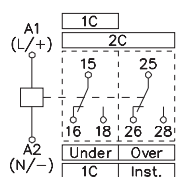
CAUTION

- Use the product within the operating ranges recommended in the specification (temperature, humidity, voltage, shock, mounting direction, atmosphere and etc.). Failure to do so might cause fire or faulty operation.
- Firmly tighten the wires to the terminal. Insufficient tightening of the wires to the terminal might cause fire.

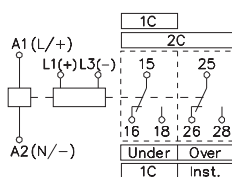
SPECIFICATIONS		NAMES AND FUNCTIONS OF FACEPLATE																									
Operating voltage	AC/DC : 100 - 240V, DC : 8 - 60V(for EP4-11060- only)																										
Allowable operating voltage range	85 ~ 110% of rated operating voltage																										
Rated frequency	50 / 60 Hz																										
Contact rating	250VAC 5A (Resistive load)																										
Display error	±1%(at 550V)																										
Power consumption	Approx. 3.3VA																										
Life	Mechanical : 5,000,000 times / Electrical : 100,000 times																										
Ambient temperature	-10 ~ +50 °C (without condensation & freezing)																										
Ambient humidity	MAX 85% RH (without condensation)																										
Altitude	MAX 2000m																										
Weight	Approx. 130g																										
SETTING PROCEDURE		DISPLAY																									
<p>1. Over voltage setting</p> <p>Set the desired value for over voltage. The display will show existing 3-phase voltages after 10 seconds.</p>		<p>1. 3-phase voltages display</p> <p>Phase-to-phase voltages are displayed in sequence.</p>																									
<p>2. Under voltage setting</p> <p>Set the desired value for under voltage. The display will show existing 3-phase voltages after 10 seconds.</p>		<p>2. Fault indications</p> <p>OVER VOLTAGE: 0418</p> <p>UNDER VOLTAGE: 342</p> <p>PHASE LOSS: -PL-</p> <p>REVERSE PHASE: -RP-</p> <p>UNBALANCE VOLTAGE: 350</p> <p>NO INPUT: - - -</p>																									
<p>3. Over voltage tripping delay setting</p> <p>Set the tripping delay for over voltage. The display will show existing 3-phase voltages after 10 seconds.</p>		<p>DIMENSIONS</p>																									
<p>4. Under voltage tripping delay setting</p> <p>Set the tripping delay for under voltage. The display will show existing 3-phase voltages after 10 seconds.</p>																											
<p>5. DIP switches setting</p> <table border="1"> <tr> <td>REV.</td> <td>ON</td> <td>Phase reversal protection ON</td> </tr> <tr> <td></td> <td>OFF</td> <td>Phase reversal protection OFF</td> </tr> <tr> <td>UNBAL.</td> <td>ON</td> <td>Unbalance protection ON</td> </tr> <tr> <td></td> <td>OFF</td> <td>Unbalance protection OFF</td> </tr> <tr> <td>AUTO</td> <td>ON</td> <td>Auto reset</td> </tr> <tr> <td></td> <td>OFF</td> <td>Manual reset</td> </tr> <tr> <td>5S/1S</td> <td>ON</td> <td>Auto reset delay 5 sec</td> </tr> <tr> <td></td> <td>OFF</td> <td>Auto reset delay 1 sec</td> </tr> </table>		REV.	ON	Phase reversal protection ON		OFF	Phase reversal protection OFF	UNBAL.	ON	Unbalance protection ON		OFF	Unbalance protection OFF	AUTO	ON	Auto reset		OFF	Manual reset	5S/1S	ON	Auto reset delay 5 sec		OFF	Auto reset delay 1 sec		
REV.	ON	Phase reversal protection ON																									
	OFF	Phase reversal protection OFF																									
UNBAL.	ON	Unbalance protection ON																									
	OFF	Unbalance protection OFF																									
AUTO	ON	Auto reset																									
	OFF	Manual reset																									
5S/1S	ON	Auto reset delay 5 sec																									
	OFF	Auto reset delay 1 sec																									
<p>6. Setting display</p> <p>Pressing "TEST" will cycle-through all settings in sequence. 3-phase voltages are displayed after 10-second of idle.</p>																											

CONNECTION

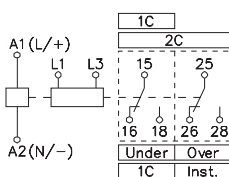
DC Voltage(8-60V)



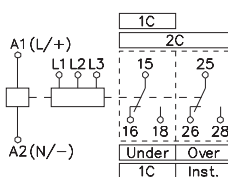
DC Voltage



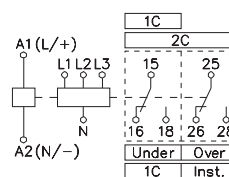
1-Phase 2-Wire



3-Phase 3-Wire



3-Phase 4-Wire

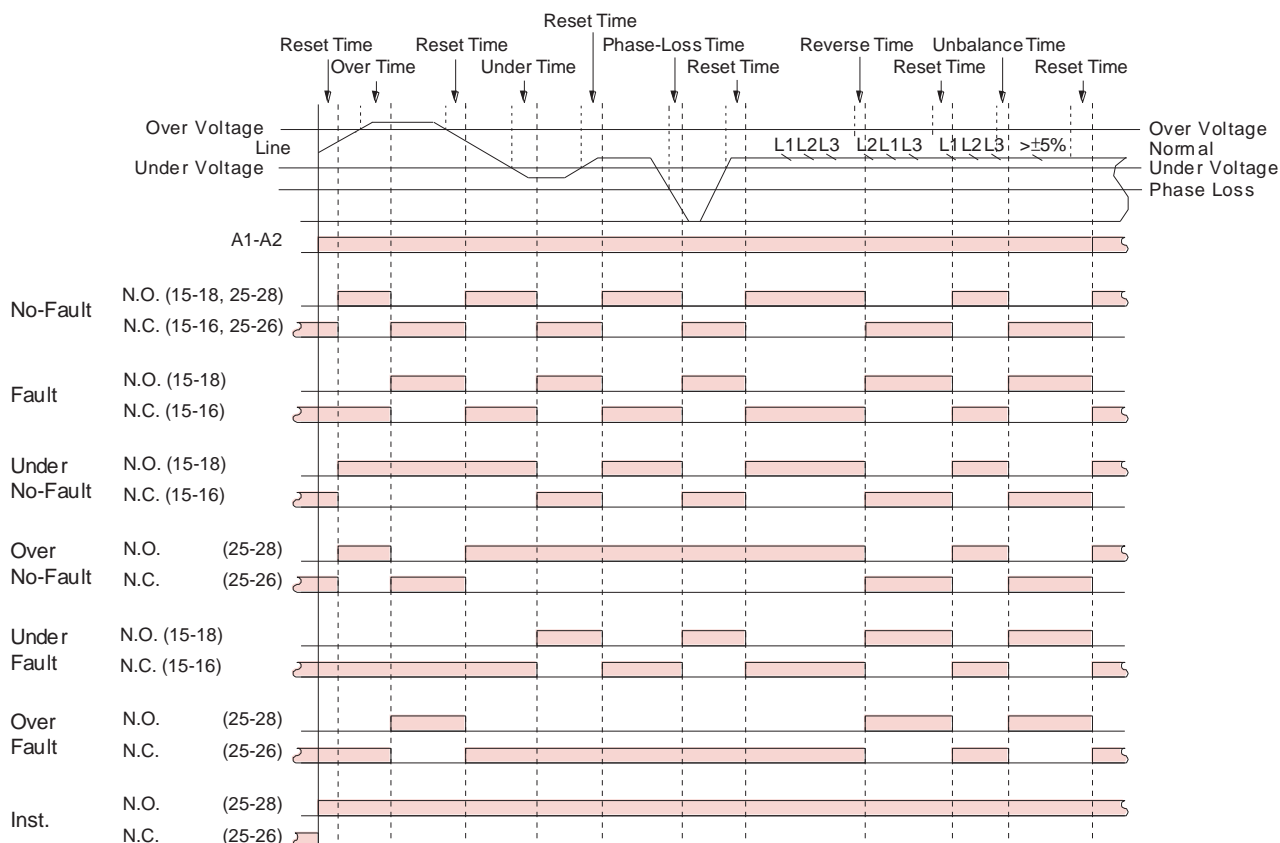


TYPE SELECTION

Voltage type		DC Type	Single Phase	3 Phase 3 Wire	3 Phase 4 Wire
		EP4-11----	EP4-12----	EP4-13----	EP4-14----
Voltage defect range	8~60V	EP4-11060-	N/A	N/A	N/A
	50~200V	EP4-11200-	N/A	N/A	N/A
	70~150V	EP4-11150-	EP4-12150-	EP4-13150-	N/A
	160~300V	EP4-11300-	EP4-12300-	EP4-13300-	EP4-14300-
	270~550V	N/A	EP4-12550-	EP4-13550-	EP4-14550-

Output contact		1C No-Fault	1C Fault	2C Over & Under Fault
		EP4-1 ----- 1	EP4-1 ----- 2	EP4-1 ----- 3
		2C Inst. & No-Fault	2C No-Fault	2C Over & Under No-Fault
		EP4-1 ----- 4	EP4-1 ----- 5	EP4-1 ----- 6

TIMING CHART



11.3 Internal wiring diagram

