# EP200

## *EP200 Paralleling Module - Operation Manual*


For use with Kutai EA04A, EA04C, ADVR-054, EA460, EA63-2.5,
and EA63-2.5S Generator Voltage Regulators

KUTAI

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ISO 9001

## SECTION 1 : SUMMARY

The **EP200** Paralleling Module is designed for use with Kutai EA04A, EA04C, ADVR-054, EA460, EA63-2.5, and EA63-2.5S generator voltage regulators.

The **EP200** enables both standard generator paralleling schemes - **reactive droop compensation and reactive differential compensation.**

The EP200 operates in parallel with an external current transformer to provide the droop signal to each generator AVR for two or more generators to share reactive loads and reduce circulating currents between generators.

An externally connected “Unit-Parallel Switch” is used to short the secondary of the current transformer and the variable burden resistor in the EP200 to allow a generator to be operated independently of the parallel generating system. (See Figure 2)

## SECTION 2 : SPECIFICATION

**Current Transformer Input**

N : 1A or N : 5A

**Power Dissipation**

Max. 1VA

**General Voltage Droop**

13% for 50% of nominal CT current

26% for 100% of nominal CT current (0 P.F)

**Environment**

| | |
|---|---|
| Operating Temperature | -40 to +60 ˚C |
| Storage Temperature | -65 to +85 ˚C |

**Dimensions**

101.0 (L) x 69.0 (W) x 47.0 (H) mm

**Weight**

255 g +/- 2%

## SECTION 3 : INSTALLATION

### 3.1 Mounting

The **EP200** module can be mounted directly on an engine or genset. The unit can be mounted in any position without affecting its operation.

### 3.2 EP200 Terminal Connections

Current Sensing Input Terminals: 0A ; 1A / 5A)

Generator line current is sensed by a current transformer (C.T) installed on the S-phase output lead (1A or 5A secondary current). The C.T secondary should be able to deliver 0.7 to 1 Amps (AC) to the 1A tap or 3.5 to 5 Amps (AC) to the 5A tap when the generator is operating at rated load and power factor.

Connecting the current transformer to the EP200 places a variable “burden resistor” across the output terminals of the transformer.

The secondary current of the current transformer induces a voltage across the variable burden resistor (DROOP Adj.) in the EP200. Voltage across the burden resistor is proportional in magnitude and to the line current through the primary of the current transformer and has the same phase. The current signal is combined with the generator’s sensing voltage signal to develop a vector summed voltage proportional to reactive load.

### 3.3 Parallel Signal Sensing Output
(Terminals 6 and 7)

The parallel signal sensing output from terminals 6 and 7 on the EP200 is connected to its generator AVR. The parallel signal sensing output is determined by the power factor of the generator load.

No error signal should be produced by the EP200 a unity power factor load (p.f.=1) and the AVR should not make any changes to excitation field because of the load. This condition is achieved by adjusting the DROOP Adj. so that the burden resistor voltage is 90 degrees out of phase with the system voltage.

When an inductive load (lagging power factor) is connected to the generator the voltage will become more in-phase with the line voltage and the vector of the two voltages results in a larger voltage being applied to the AVR sensing circuit. The AVR reduces field excitation to decrease generator voltage.

When a capacitive load (leading power factor) is applied to the generator the voltage across the Droop Adj. potentiometer becomes out of phase with the sensing voltage and the combined vector of the two voltages results in a smaller voltage being applied to the AVR sensing circuit and the AVR reacts by increasing generator voltage.

## SECTION 4 : PARALLEL COMPENSATION

When two or more generators are operating in parallel the field excitation of any one generator can become excessive and the difference in voltage will cause a circulating current to flow between generators.

The parallel compensation circuit in the EP200 will cause the AVR to increase the field excitation on the generator with the lower field excitation and decrease the field excitation on the generator with the higher field excitation. By controlling the reactive load the parallel compensation circuit can eliminate the undesired circulating currents.

When **reactive droop compensation** is used to parallel two or more generators each parallel droop circuit is independent of the other. With droop compensation the bus voltage will droop with changing reactive load.

**Reactive differential compensation** allows two or more paralleled generators in an isolated system to share inductive, reactive loads with no decrease or droop in the generator system output voltage. This is accomplished by the same circuit described previously for reactive droop compensation but also cross connection of all CT secondary leads. (Figures 3 and 4)

Figures 3 and 4 show the first CT connected to the start of the second CT, etc. until all CTs are connected in series. The final step is to connect the last CT to the start of the first CT. This forms a closed, series loop that interconnects the CTs of all generators to be paralleled. The signals from the interconnected CTs cancel each other when the line currents are proportional and in phase and no drop in system voltage occurs.

When generators are paralleled with reactive droop compensation generators are usually set to operate with maximum droop, i.e. the burden resistor is adjusted for maximum resistance or maximum voltage across the resistor. Allowing the generating system to operate at maximum droop allows for the best control of circulating currents.

Reactive differential compensation can be used only if all AVRs are identical and if the regulators on all the generators operating on a common bus are cross connected into the closed series loop. Generators of different kW ratings may be operated with reactive differential compensation if parallel CTs are selected that give approximately the same secondary current of the rated load of each generator.

## SECTION 5 : PARALLEL OPERATION

Before parallel operation of generators using EP200 the following checks are necessary to confirm that the correct polarity and phase relationship exists between the generator AVR, the parallel current transformer, and the EP200. Repeat this test for all units that are to be paralleled.

If reactive differential compensation method is used then the interconnection loop between the generators should be left open until completing these tests. (See Figures 3 and 4.)

5.1 Adjust the “Droop ADJ.” potentiometer on the EP200 to max. resistance (fully clockwise).

5.2 Set the external Unit-Parallel switch to “Unit” or place a jumper across terminals 0A and 1A on the EP200.

5.3 With the generator operating at rated speed and voltage connect a lagging power factor load. (Unity power factor load cannot be used for this test.) Record the generator voltage.

5.4 With a lagging power factor load still applied place the Unit-Parallel switch in the “Parallel” position and record the generator voltage.

5.5 Verify that the voltage obtained with the switch set to “Parallel” is less than the voltage obtained with the switch set to “Unit”.

5.6 If a higher voltage was obtained with the switch set to “Parallel”, stop the system and verify that the CT and sensing leads are connected to the correct generator lines. If all connections are correct then swap the parallel CT secondary leads.

5.7 If step 6 was required, then repeat steps 1 through 4 to ensure that the system voltage droop is obtained.

**NOTE**

**During single-unit operation the Unit-Parallel Switch shorts terminals 0A and 1A to prevent any droop signal from being supplied to the regulating system. The system may be still be operated with Unit-Parallel switch in the Parallel position if the voltage droop that results from the load is not objectionable.**

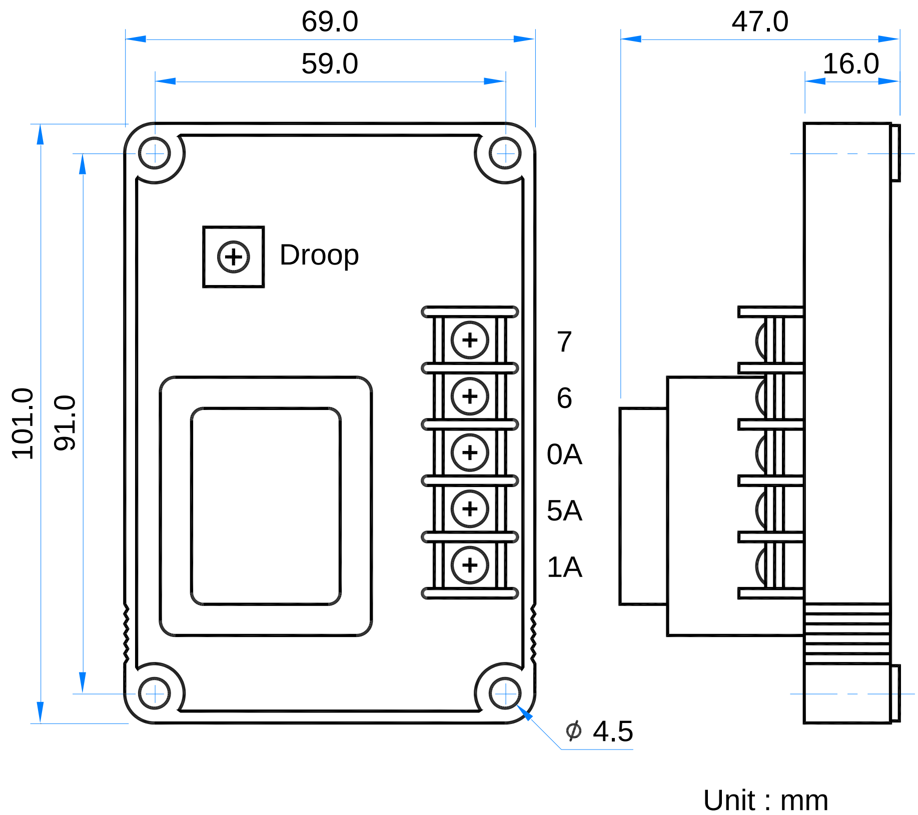


Figure 1 Mounting Dimensions

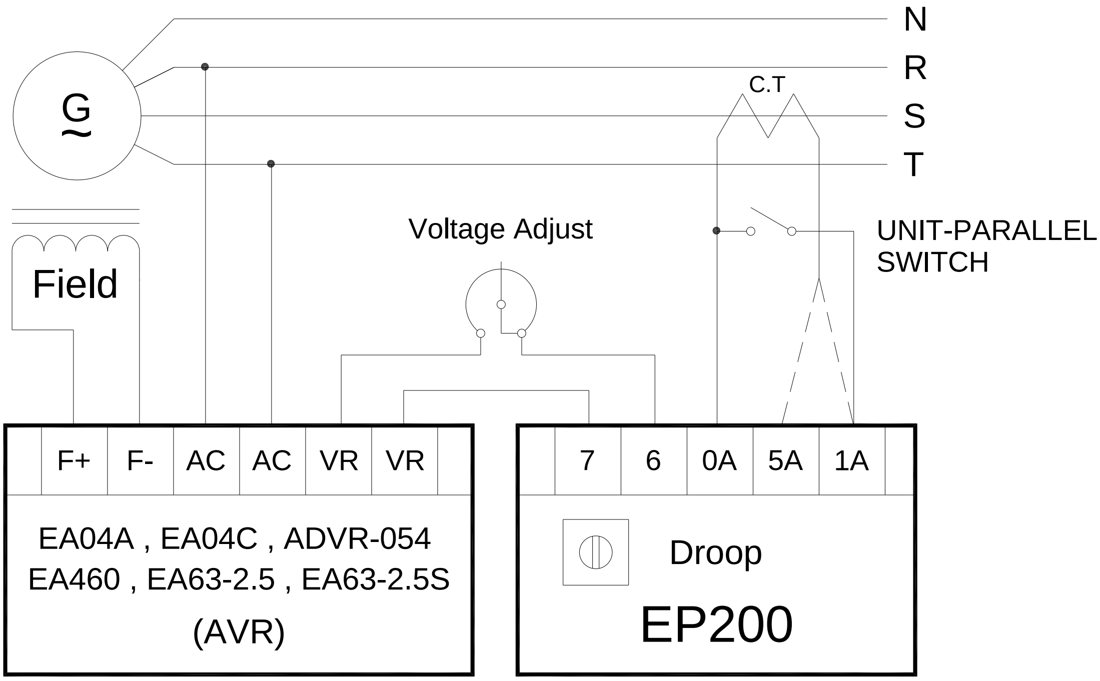


Figure 2 Wiring

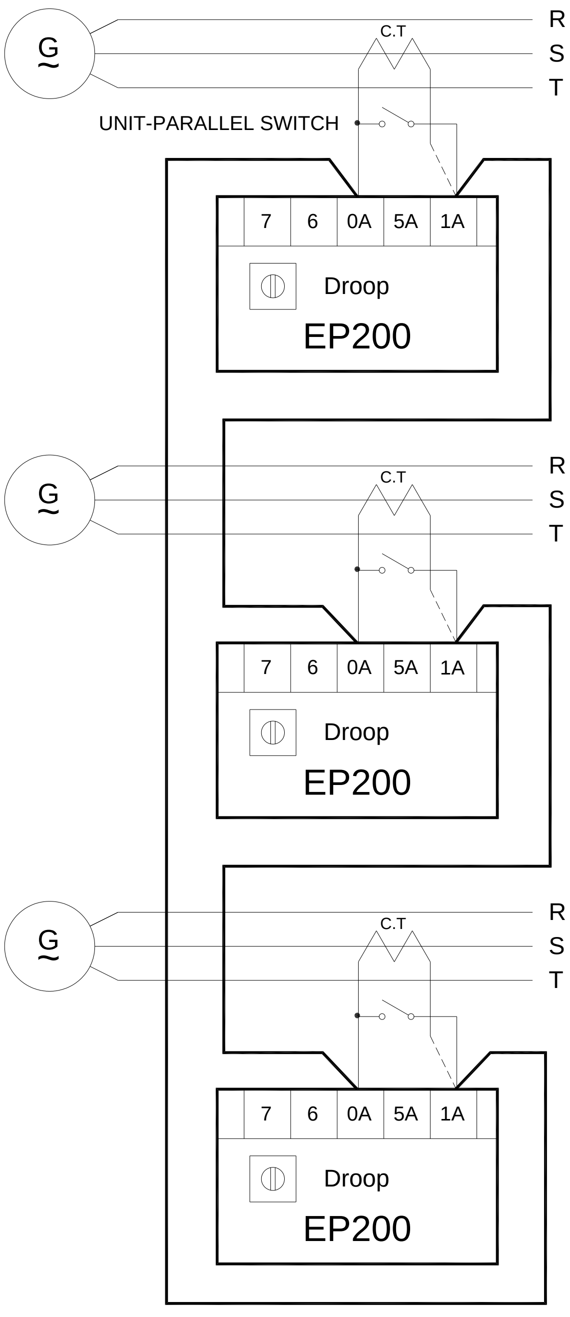


Figure 3 C.T 1A Interconnection Diagram

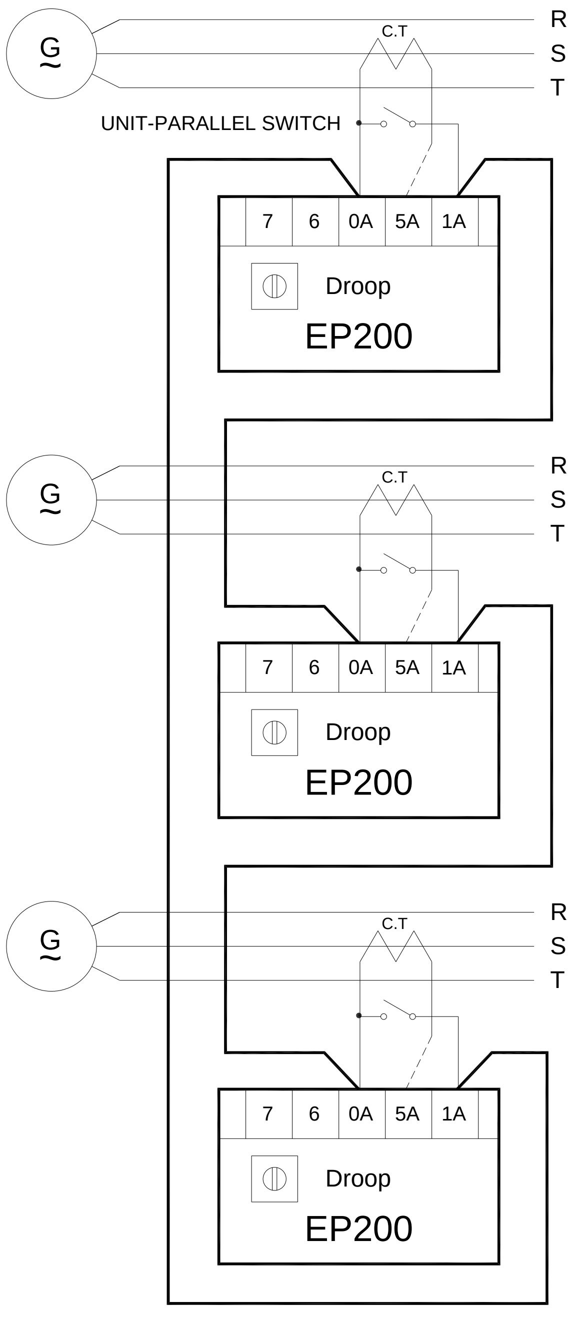


Figure 4 C.T 5A Interconnection Diagram