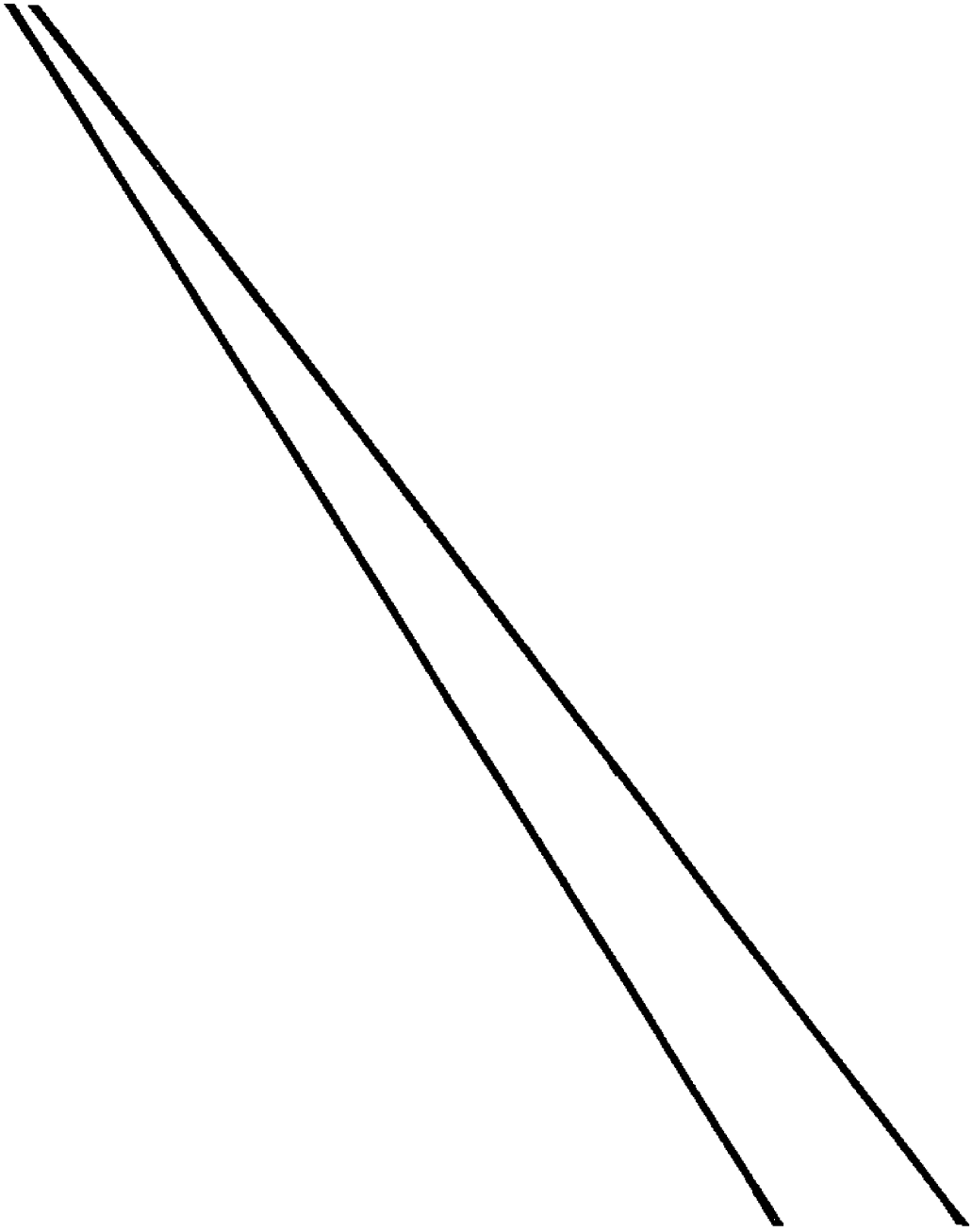
INSTRUCTION MANUAL



Basler Electric
Highland, Illinois

Paralleling Module
Model APM 300
Part Number: 90 58200 100

Publication
Number: A90 58200 99X
Date: March 25, 1975
Change 1: May 16, 1980

WARNING

TO PREVENT POSSIBLE PERSONAL INJURY OR EQUIPMENT DAMAGE, ONLY QUALIFIED TECHNICIANS/OPERATORS SHOULD INSTALL, OPERATE AND/OR SERVICE THIS DEVICE.

CAUTION

MEGGERS AND HIGH POTENTIAL TEST EQUIPMENT SHOULD NOT BE USED. INCORRECT USE OF SUCH EQUIPMENT COULD DAMAGE COMPONENTS CONTAINED IN THIS DEVICE.

SECTION 1.0

1.1 PURPOSE

The Paralleling Module, APM 300, is designed for use with any of the Basler KR-F, KR-FF and KT series regulators (also, SR regulators not containing internal paralleling provision). The device simplifies the installation of paralleling components by placing them in modular construction. The APM 300 offers the use of standard paralleling schemes, for either droop or cross-current load compensation. Droop adjustment is by built-in slider wire resistor (R1). An internal pre-wired unit-parallel mode switch (S1) is also provided on the chassis.

The Paralleling Module works in conjunction with an external parallel current transformer. The paralleling accessory provides the reactive droop signal necessary to allow generators to share reactive loads and reduce circulating currents between them.

The voltage regulator and paralleling module must be connected into the generating system as shown in the interconnection diagrams.

1.2 SPECIFICATIONS

Part Number	90 58200 100
Input Power	
Voltage	120/208-240/416-480/600 VAC
Current	5 Amps, 25 VA
Voltage Droop	Adjustable to Approximately 5%
Ambient Temperature	-40°C to +70°C (-40°F to +158°F)

Vibration and Shock - This module is designed to operate when mounted directly on an electric motor, gasoline, diesel, or turbine driven generator system. It can also be mounted in the switchgear or control panel.

Weight	Approximately 3.5 pounds

SECTION 2.0

2.1 THEORY OF OPERATION

The paralleling module operates with a 5 amp (25 VA) secondary current transformer installed in generator phase B. If three phase sensing is used, a second CT, installed in the generator A phase, is also required. The CT secondary should deliver from 3 to 5 amps at rated load. The CT develops a voltage signal across an adjustable resistor R1 in the paralleling accessory which is proportional in amplitude and phase to the generator line current. This voltage is applied to the primary of transformer T1. The secondary of this transformer is connected in series with the voltage applied to the voltage regulator sensing circuit. The result is that the voltage applied to the voltage regulator sensing circuit is the vector sum of the generator AC voltage and the voltage developed by the paralleling accessory. The voltage supplied by the paralleling accessory is small in relation to the generator voltage.

When a resistive load (Unity P.F.) is applied to the generator, the voltage that appears across R1 (and T1) leads the sensing voltage by 90 degrees, and the vector sum of the two voltages is nearly the same as the original sensing voltage; consequently, almost no change occurs in the generator output voltage.

When a lagging power factor (inductive) load is applied to the generator, the voltage across R1 becomes more in phase with the sensing voltage and the combined vectors of the two voltages result in a larger voltage being applied to the voltage regulator sensing circuit. Since the action of the regulator is to maintain a constant voltage at its sensing terminals, the regulator reacts by decreasing the generator voltage.

When a leading power factor (capacitive) load is applied to the generator, the voltage across R1 becomes out of phase with the sensing voltage and the combined vectors of the two voltages result in a smaller voltage being applied to the voltage regulator sensing circuit. The regulator will then react by increasing the generator voltage.

When two generators are operating in parallel, if the field excitation on one generator should become excessive, and cause a circulating current to flow between generators, this current appears as a lagging power factor (inductive) load to the generator with excessive field current and a leading power factor (capacitive) load to the other. The parallel compensation circuit will cause the voltage regulator to decrease the field excitation on the generator with the lagging power factor load, so as to minimize the circulating currents between the generators.

This action and circuitry is called parallel droop compensation. It allows two or more paralleled generators to proportionally share inductive loads by causing a decrease or droop in the generator system voltage.

These parallel modules provide the necessary circuit isolation for parallel cross-current compensation operation. Parallel cross-current compensation allows two or more paralleled generators to share inductive reactive loads with no decrease or droop in the generator system output voltage. This is accomplished by the action and circuitry described

previously for parallel droop compensation, and the addition of cross connecting leads between the CT secondaries shown in Figure 2. Figure 2 shows the finish of the first CT connected to the start of the third CT, etc. until all CT's are connected in series. The final step is to connect the finish of the last CT to the start of the first CT. This forms a closed series loop which interconnects the CT's of all generators to be paralleled. The signals from the interconnected CT's cancel each other when the line currents are proportional and in phase and no drop in system voltage occurs.

Cross-current compensation can be used only if the regulators are identical and if the regulators on all the generators operating on a common bus are interconnected into the cross-current loop. Generators of different KW ratings may be operated with cross-current compensation if parallel CT's are selected that give approximately the same secondary current of each generator's rated load.

On parallel cross-current compensation applications consisting of more than two generators, the Unit-Parallel switch should be placed in the UNIT position on any generating system that is not on the load bus. If it is not, a voltage droop will be introduced into the system. This is because the unloaded generator parallel CT is not supplying its compensating signal, but allowing a voltage drop to occur across it. This drop will also cause the voltage of the incoming generator to fluctuate prior to paralleling. If this fluctuation is objectionable, it can be eliminated by utilizing an auxiliary contact on the main generator circuit breaker. This auxiliary contact should be connected across the parallel CT secondary and be closed when the main generator circuit breaker is open, and opens when the main generator circuit breaker closes. When this auxiliary contact is used, the Unit-Parallel switch in the paralleling modules is left in the PARALLEL position.

2.2 PARALLELING PROCEDURE

It is recommended that the following test be performed before paralleling to confirm that correct polarity and place relationships exist between the voltage regulator, parallel current transformer, and paralleling accessory.

NOTE

If cross-current compensation type of operation is used, the cross-current loop should be left open until completing these tests.

Step 1. Adjust slide on R1 (Paralleling Accessory) to the maximum resistance position. (end of resistor closest to terminal strip).

Step 2. Place Unit-Parallel switch in UNIT position.

Step 3. With one system operating at the rated speed and voltage, apply a lagging power factor load. (Unity power factor load cannot be used for this test). Record generator voltage.

Step 4. With load still applied, place Unit-Parallel switch in PARALLEL position and again record the generator voltage.

Step 5. The voltage obtained when switch is in PARALLEL position should be less (approximately 5%, depending on load) than when switch is in UNIT position.

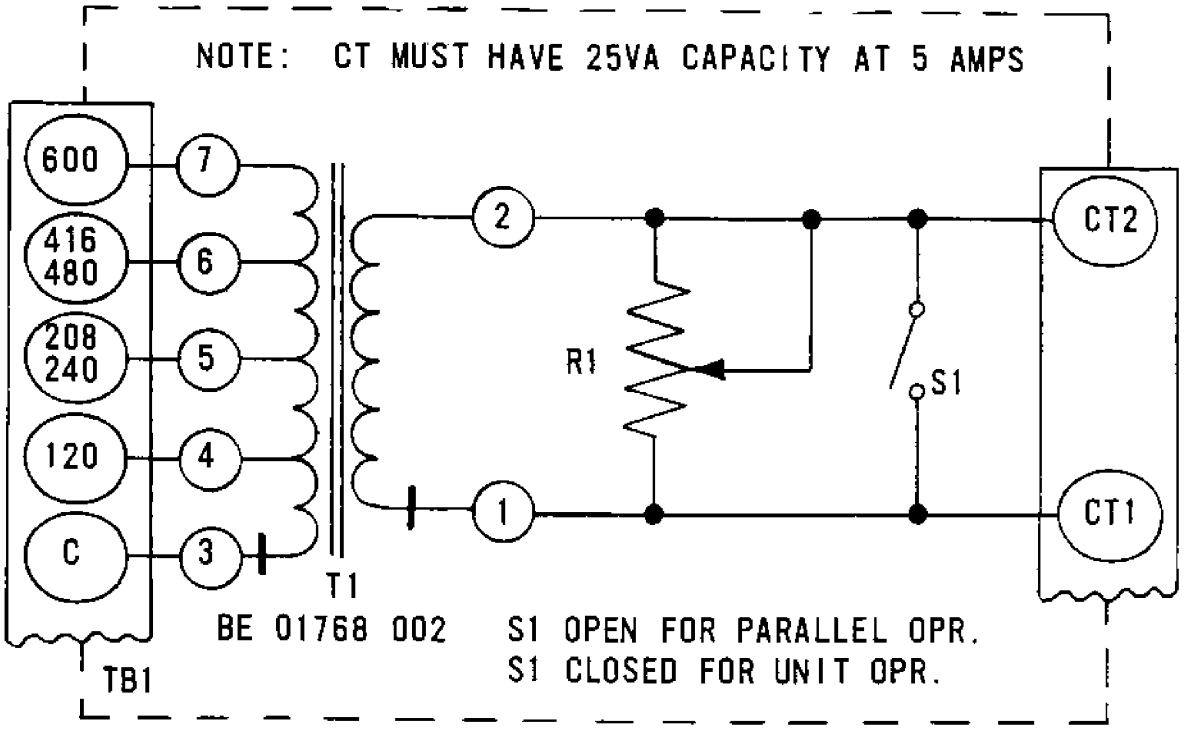
Step 6. If a higher voltage is obtained when switch is in PARALLEL position, shut down the system and verify CT and sensing leads are to correct generator lines. If all connections are correct, interchange the parallel CT secondary leads.

Step 7. If step 6 was required, steps 1 through 4 should be repeated, to be certain that system voltage droop is obtained.

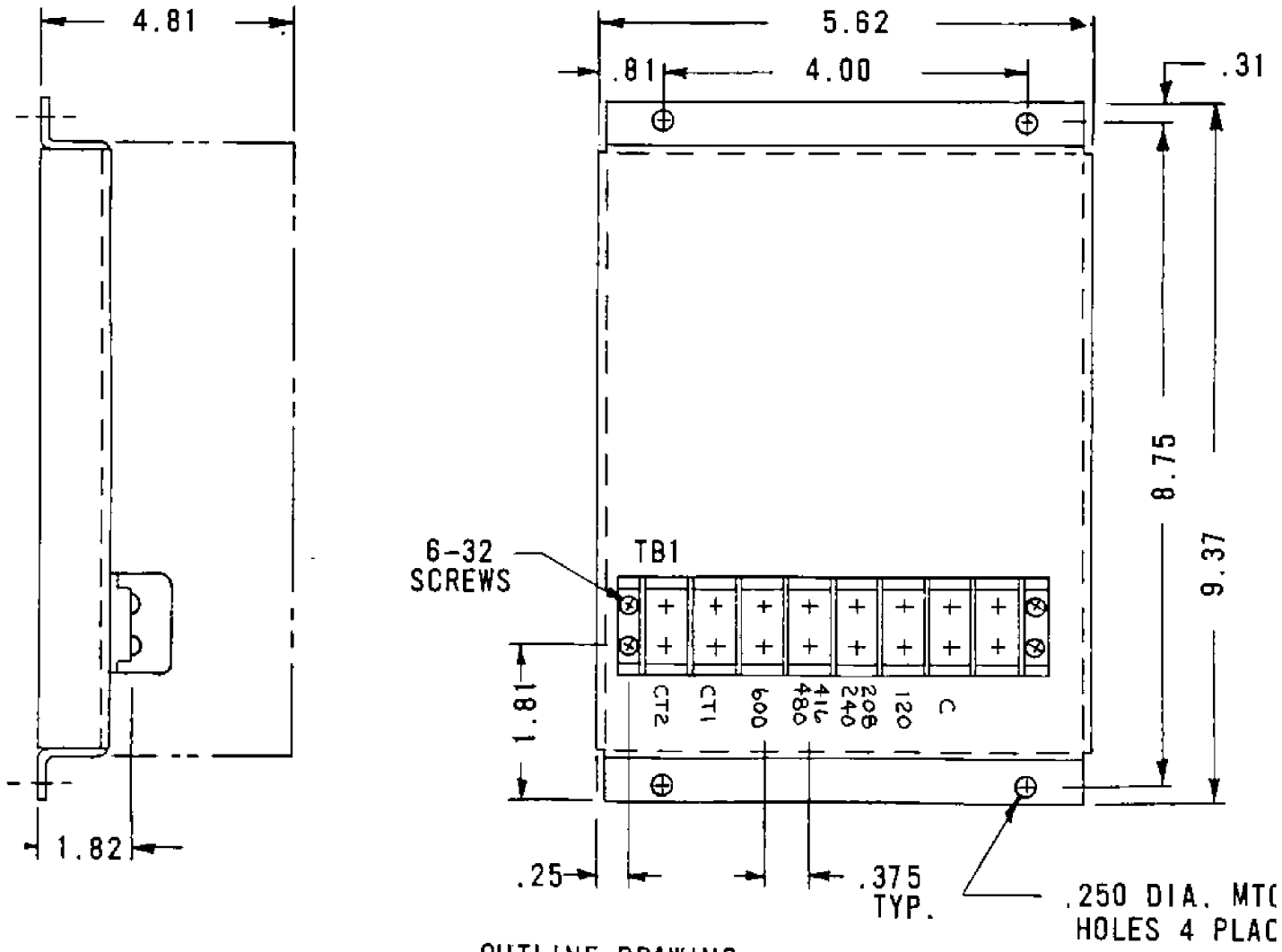
Perform the above test on all systems that are to be paralleled.

NOTE

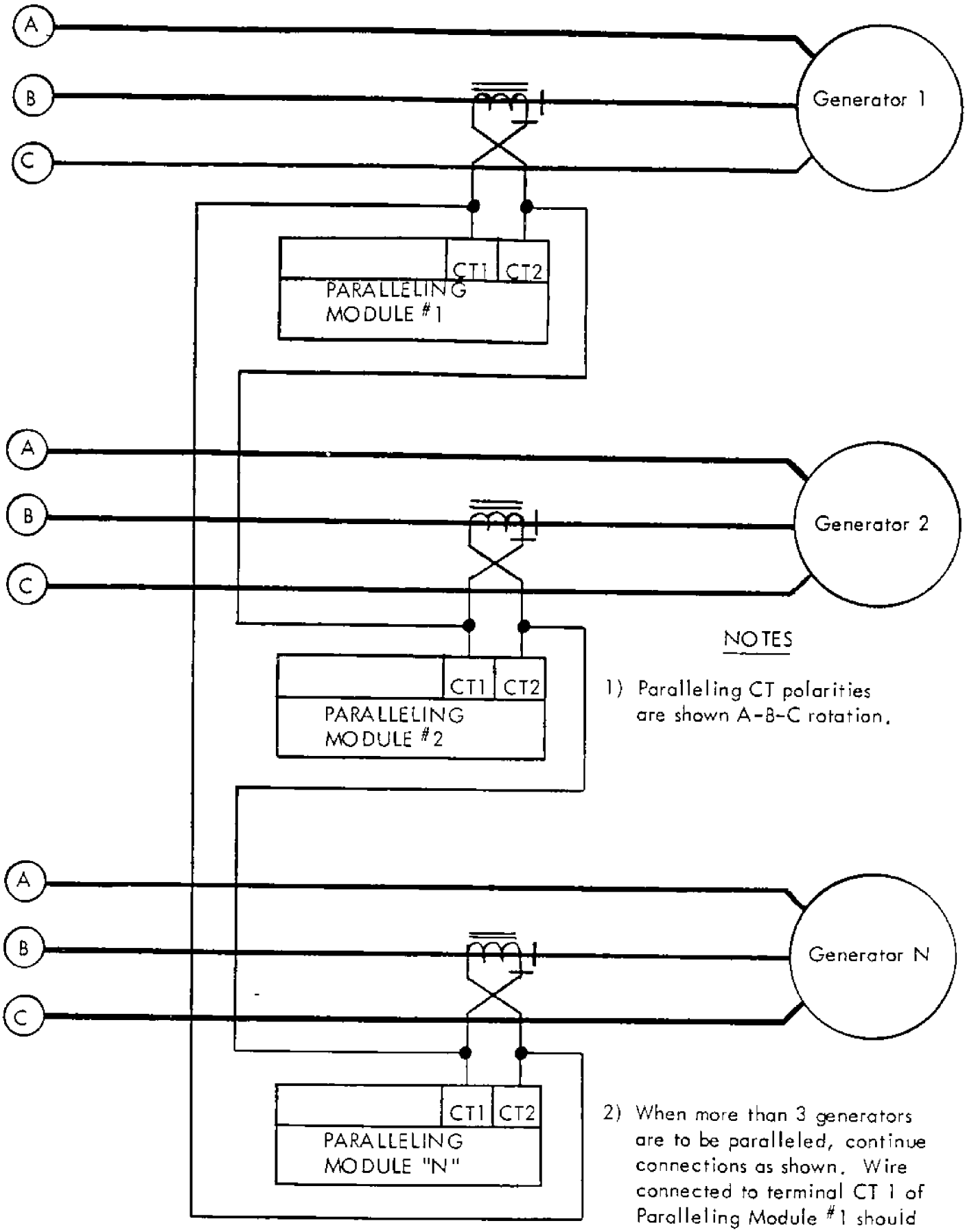
During single unit operation, the Unit-Parallel switch should be in UNIT position. The switch shorts the parallel CT secondary and prevents any droop signal from being injected into the regulating system. The system may be operated in PARALLEL position if the voltage droop that results with the load is not objectionable.



SCHEMATIC DIAGRAM
FIGURE 3



OUTLINE DRAWING
FIGURE 4



NOTES

1) Paralleling CT polarities are shown A-B-C rotation.

2) When more than 3 generators are to be paralleled, continue connections as shown. Wire connected to terminal CT 1 of Paralleling Module #1 should terminate at terminal CT 2 of the last Paralleling Module being used ("N").

Figure 2 - Cross-Current-Compensation CT Interconnection