INSTRUCTION
MANUAL

Basler Electric
Highland, Illinois

CURRENT BOOST SYSTEM
Model Numbers: CBS-344
CBS-377
Part Numbers: 9 1096 00 103
9 1096 00 102

Publication
Number: 9 1096 00 990
Date: October 7, 1977
Change 3: August 1982

SECTION 1.0

INTRODUCTION

1.1 GENERAL

The purpose of the Current Boost System is to assist the KR voltage regulator during generator overload conditions such as motor starting and to independently supply the generator exciter field current during generator short circuit faults. The CBS will permit a 3 wire generator to support any sustained 3 phase line-to-line or single phase line-to-line short circuit.

1.2 SPECIFICATIONS

TABLE 1

MODEL	INPUT POWER*		OUTPUT POWER		INPUT SENSING	
	Ampere Turns		DC Volts (Max.)	DC Amps (Max.)	Volts	Burden
	CT Terminals 1 to 2	CT Terminals 1 to 3				
CBS-344 (Used with KR4F/FF Regulator)	800 to 2000	2000 to 5000	90 Vdc	3.5A	120V	10 VA
CBS-377 (Used with KR7F/FF Regulator)	1200 to 3000	3000 to 7000	180 Vdc	5A	240V	10 VA

* Input Power refers to the number of CT ampere turns required and the CT secondary terminals to use.

Operating Temperature Range:	-40°F (-40°C) to +140°F (+60°C)
Shock:	Withstands up to 15 G's in each of three mutually perpendicular planes.
Vibration:	Withstands 5 to 26 Hz. @ 1.2 G's; 27 to 52 Hz. @ 0.036 double amplitude; 53 to 260 Hz @ 5.0 G's.
Dimensions:	7.12 in. (180.97 mm) by 7.10 in. (180.34 mm) by 3.93 in. (99.99 mm)
Weight:	4.5 lbs. (2.03kg) net.

SECTION 2.0

THEORY OF OPERATION
(Refer to Figure 2-1)

2.1 CURRENT TRANSFORMER

The associated current transformer provides operating power for the CBS-344/377 units. Secondary coil taps are provided to select appropriate ampere turns (See paragraph 4.3 or 4.4).

2.2 DC OUTPUT CIRCUIT

The DC output circuit contains power bridge rectifier circuit and two SCR's in series with the A.C. input. When the SCR's are turned off the power bridge rectifier circuit supplies boost current to the exciter field. If the SCR's are turned on continuously, the A.C. input will be shorted, which removes the DC output voltage. The DC output circuit is controlled by two associated circuits; the firing circuit and the voltage limiting circuit.

2.3 FIRING CIRCUIT

During normal generator system operation the firing circuit will ensure continuous conduction of the DC output circuit SCR's (the continuous conduction of the SCR's removes the DC output). If the generator output voltage deceases below the comparator circuits preset limit, the firing circuit will turn off. This causes the DC output circuit to turn on and supply boost current.

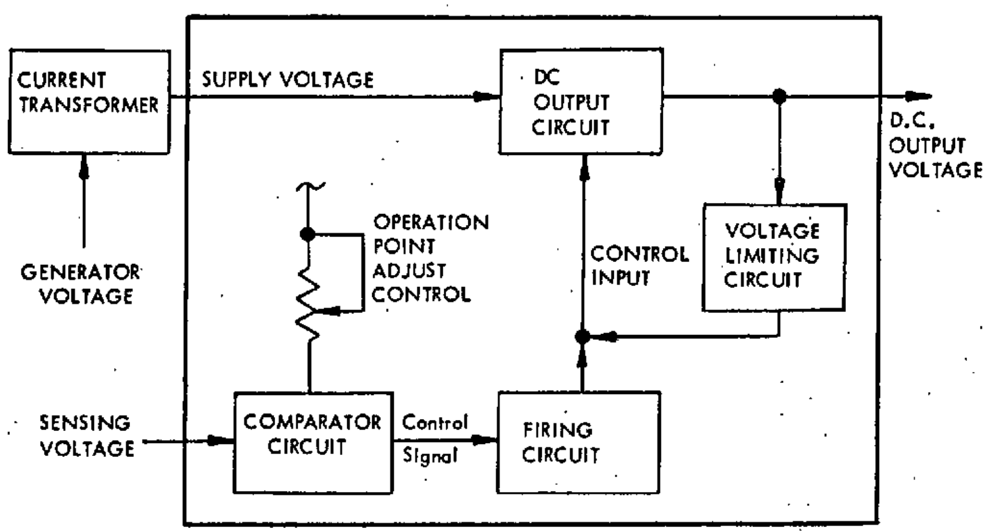


FIGURE 2-1 FUNCTIONAL BLOCK DIAGRAM

2.4 VOLTAGE SENSING

The A.C. generator voltage is stepped down to a required level, rectified and the resultant DC signal is applied to the comparator circuit.

2.5 COMPARATOR CIRCUIT

The comparator circuit compares the sensing voltage with a preset reference voltage established by the operation point adjustment control (R13). If the generator voltage decreases below the value set by R13, the comparator circuit enables the Firing Circuit. When the generator voltage increases above the operating point, the comparator circuit disables the Firing Circuit to remove the boost current.

2.6 VOLTAGE LIMITING CIRCUIT

The voltage limiting circuit monitors the DC output voltage and adjust the firing angle of the DC output circuit SCR's to limit the DC output to 90 Vdc for the CBS-344 and 180 Vdc for the CBS-377.

SECTION 3.0

CONTROLS AND INDICATORS

3.1 OPERATION POINT ADJUSTMENT CONTROL (R13)

This screwdriver adjustment establishes the nominal generator voltage which is to be maintained. If the control is rotated clockwise (CW), the CBS operating point is increased. If the control is rotated counterclockwise (CCW), the CBS operating point is decreased. The CBS-344/377 will activate when the nominal generator voltage has decreased to the value set by the operation point adjustment control (See table 4). Refer to paragraph 4.5 for system calibration instructions.

3.2 OPERATION POINT INDICATOR

It is used for CBS-344/377 calibration. Refer to paragraph 4.5 for system calibration instructions.

SECTION 4.0

INSTALLATION AND OPERATION

4.1 MOUNTING

This unit is convection cooled and should not be mounted near heat generating equipment or inside totally enclosed switchgear where the temperature rise could exceed its operating limit. Vertical mounting is recommended to obtain optimum convection cooling.

4.2 INTERCONNECTION

CAUTION

MEGGERS AND HIGH POTENTIAL TEST EQUIPMENT MUST NOT BE USED. INCORRECT USE OF SUCH EQUIPMENT MAY DESTROY THE SEMICONDUCTORS IN THE CBS MODULE.

The regulator connects with the generator system as shown on the interconnection diagram, Figure 6-3. Note: Generators employing a fourth wire neutral may not sustain short circuit current between the neutral and the line not being "sampled" by a current transformer.

4.3 CURRENT TRANSFORMER TURNS SELECTION (CBS-344)

To determine the number of primary turns required for a particular Current Boost System installation, perform the following steps.

1. Determine exciter field current during generator short circuit from the following formula:

$$\text{Exciter Field Current during generator short circuit} = \frac{90 \text{ Vdc}}{\text{Exciter Field Resistance}}$$

NOTE

IF THE CALCULATED CURRENT EXCEEDS FOUR AMPERES, THE KR4F/FF REGULATOR CANNOT BE USED.

2. From the short circuit saturation data (plot of exciter field current versus line current with the output of the generator shorted circuited), available from the generator manufacturer, determine the generator short circuit line current that would result from the exciter field current calculated in step 1.

3. In table 2, note the intersection of the "Generator Short Circuit Line Current" row and the "Exciter Field Current During Generator Short Circuit" column. Use this number (example: 900 Ampere Turns) in the step 4 formula.

4. Using the Ampere truns found in step 3, determine the number of primary turns required for each of two phases from the following formula (the two generator lines passing thru the CT must be in opposite directions):

$$\text{Number of Primary Turns Required} = \frac{\text{Ampere Turns from Table 2}}{\text{Generator Short Circuit Line Current} \times 1.73}$$

NOTE

If the calculated number of turns contains a fractional turn, the fraction may be ignored if the fractional value is less than or equal to 10% of the total whole turns. If the fractional value is greater than 10% of the total whole turns, increase the total whole turns by one. Example:
If the calculated turns equal 4.4 turns, ignore the fractional value.
If the calculated turns equal 4.5, round off the value to 5.0 whole turns.

5. Select transformer secondary terminals from the condition below.
   If the generator short circuit line current is:

   25 Amps. to 1155 Amps. - use secondary terminals 1-2.
   1156 Amps. to 2000 Amps. - use secondary terminals 1-3.

TABLE 2

Generator Short Circuit Line Current	Exciter Field Current During Generator Short Circuit		
	2 Amps Or Less	Greater Than 2 Amps. But Less Than Or Equal To 3 Amps.	Greater Than 3 Amps. But Less Than Or Equal To 4 Amps.
25 Amps. to 1155 Amps.	600 Ampere Turns	900 Ampere Turns	1200 Ampere Turns
1156 Amps. to 2000 Amps.	1500 Ampere Turns	2200 Ampere Turns	3000 Ampere Turns

4.4 CURRENT TRANSFORMER TURNS SELECTION (CBS-377)

To determine the number of primary turns required for a particular Current Boost System installation, perform the following steps:

1. *Determine exciter field current during generator short circuit from the following formula:*

$$\text{Exciter Field Current during generator short circuit} = \frac{180\ \text{Vdc}}{\text{Exciter Field Resistance}}$$

NOTE

IF THE CALCULATED CURRENT EXCEEDS SIX AMPERES, THE KR7F/FF REGULATOR CANNOT BE USED.

2. From the short circuit saturation data (plot of exciter field current versus line current with the output of the generator short circuited), available from the generator manufacturer, determine the generator short circuit line current that would result from the exciter field current calculated in step 1.

3. In Table 3, note the intersection of the "Generator Short Circuit Line Current" row and the "Exciter Field Current During Generator Short Circuit" column. Use this number (example: 1350 Ampere Turns) in the step 4 formula.

4. Using the ampere turns found in step 3, determine the number of primary turns required for each of two phases from the following formula (the two generator lines passing thru the CT must be in opposite directions):

$$\text{Number of Primary Turns Required} = \frac{\text{Ampere Turns from Table 3}}{\text{Generator Short Circuit Line Current} \times 1.73}$$

If the calculated number of turns contains a fractional turn, the fraction may be ignored if the fractional value is less than or equal to 10% of the total whole turns. If the fractional value is greater than 10% of the total whole turns, increase the total whole turns by one. Example: If the calculated turns equal 1.09 turns, ignore the fractional value. If the calculated turns equal 1.2, round off the value to 2.0 whole turns.

5. Select transformer secondary terminals from the conditions below.
If generator short circuit line current is:

500 Amps. to 1734 Amps. - use secondary terminals 1-2.
1735 Amps. to 4000 Amps. - use secondary terminals 1-3.

TABLE 3

Generator Short Circuit Line Current	Exciter Field Current During Generator Short Circuit		
	3 Amps. Or Less	Greater Than 3 Amps. But Less Than Or Equal To 4.5 Amps.	Greater Than 4.5 Amps But Less Than Or Equal To 6 Amps.
500 Amps. To 1734 Amps.	900 Ampere Turns	1350 Ampere Turns	1800 Ampere Turns
1735 Amps. To 4000 Amps.	2250 Ampere Turns	3375 Ampere Turns	4500 Ampere Turns

4.5 SYSTEM CALIBRATION INSTRUCTIONS

Perform the following steps to adjust the CBS operation point.

1. With the generator at no-load, ensure the Operation Point Adjustment Control is rotated fully clockwise.
2. Reduce generator voltage to the desired CBS turn-on value.
3. Rotate the Operation Point Adjustment Control counterclockwise until the Operation Point Indicator (LED) turns off.
4. Return the generator voltage to nominal.
5. Table 4 below correlates settings of the Operation Point Adjustment Control with approximate sensing voltage.

TABLE 4

Operation Point Adjustment Control Setting	APPROXIMATE THRESHOLD SENSING VOLTAGE	
	CBS-344	CBS-377
1	67	128
2	71	134
3	76	143
4	82	155
5	88	168
6	95	186
7	107	205
8	120	231
9	136	256
10	145	285

SECTION 5.0

SPARE PARTS

5.1 GENERAL

The spare parts list, Table 5-1, identifies those basic parts and assemblies of the CBS-344/377 with maintenance significance. When ordering parts, specify the complete part number of the CBS-344/377, a description of the component part, and the Basler part number.

TABLE 5-1

DESCRIPTION	REFERENCE DESIGNATION	BASLER NUMBER
Circuit Board Assembly	---	9 1096 02 100 (CBS-377)
Circuit Board Assembly	---	9 1096 02 103 (CBS-344)
Current Transformer	---	BE 15486 001
Silicon Controlled Rectifier (2N1849A)	SCR-1, SCR-2	06899
Diode (1N3671A)	CR1, CR2	02677
Diode (1N3671AR)	CR3, CR4	06721
L.E.D. (RED)	CR13	08590
Capacitor - 4 microfarad, 370V, 10%	C1	04870
Capacitor - 550 microfarad, 250V, -10%, +50%	C2	10908
Resistor - 5,000 ohm, 2 watt 10% variable	R13	06935

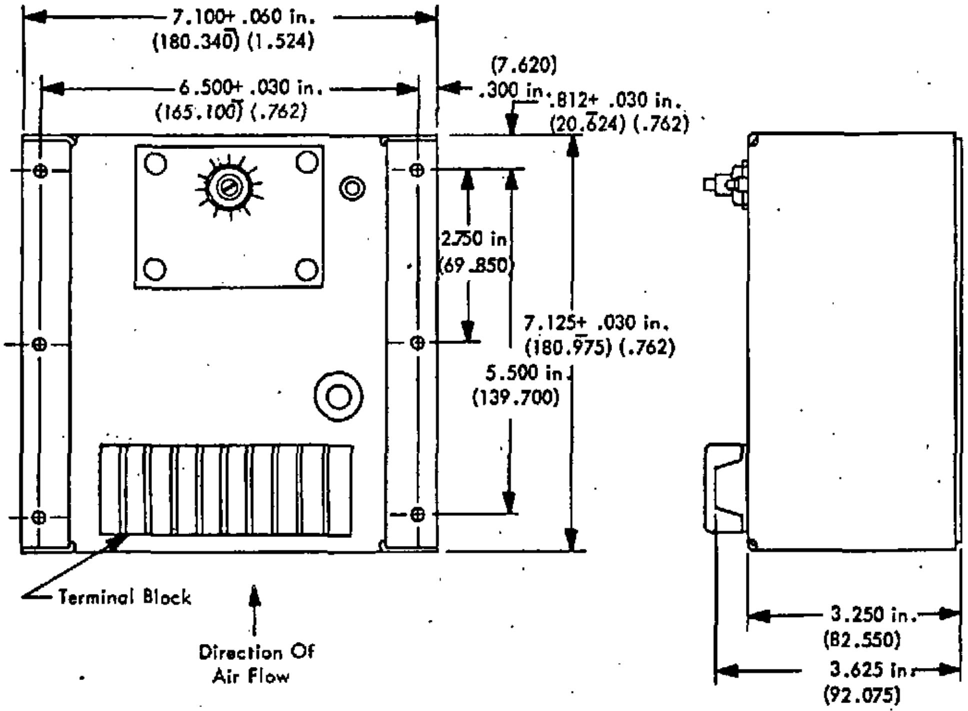
SECTION 6.0

DRAWINGS

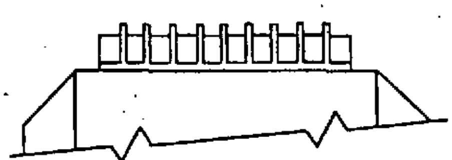
6.1 GENERAL

This section contains drawings and diagrams to facilitate installation, operation and maintenance of the current boost system.

Figure 6-1 Outline Drawing
Figure 6-2 Current Transformer Drawing
Figure 6-3 System Interconnect CBS-344/377.

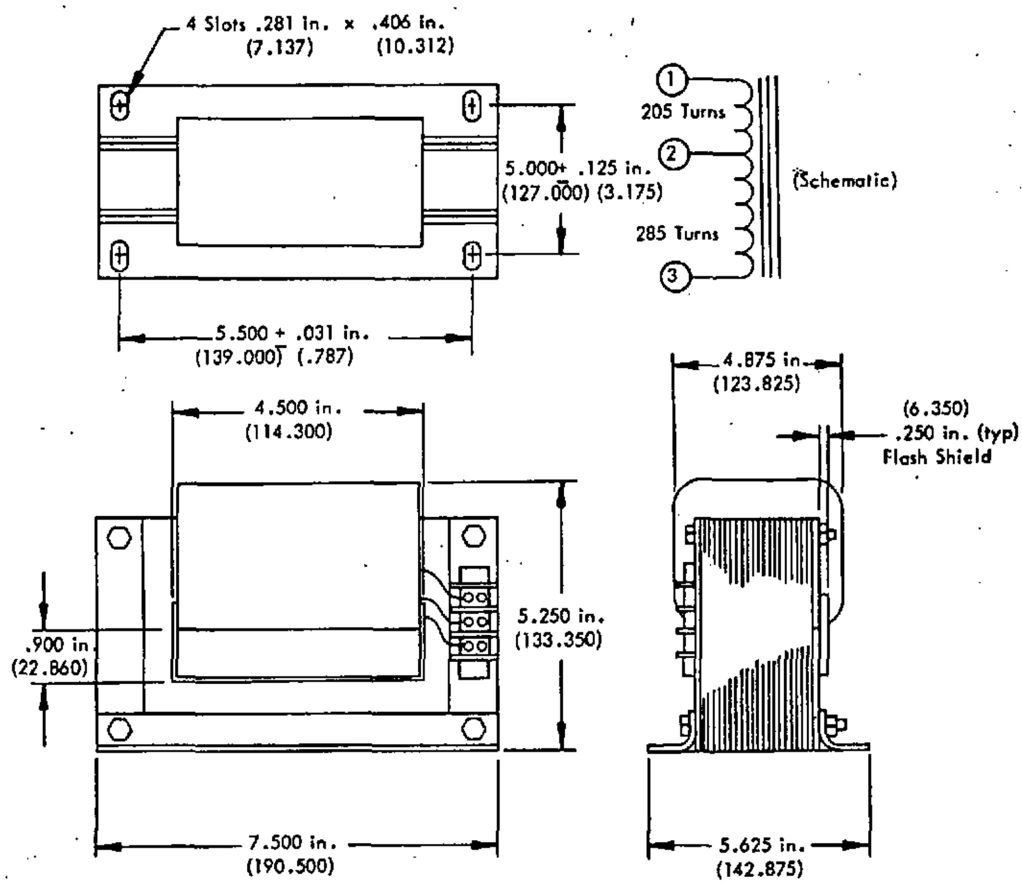


Approximate Weight 5.00 lbs.
(2.26 kg.)



Numbers in parentheses indicate metric dimensions (millimeters)

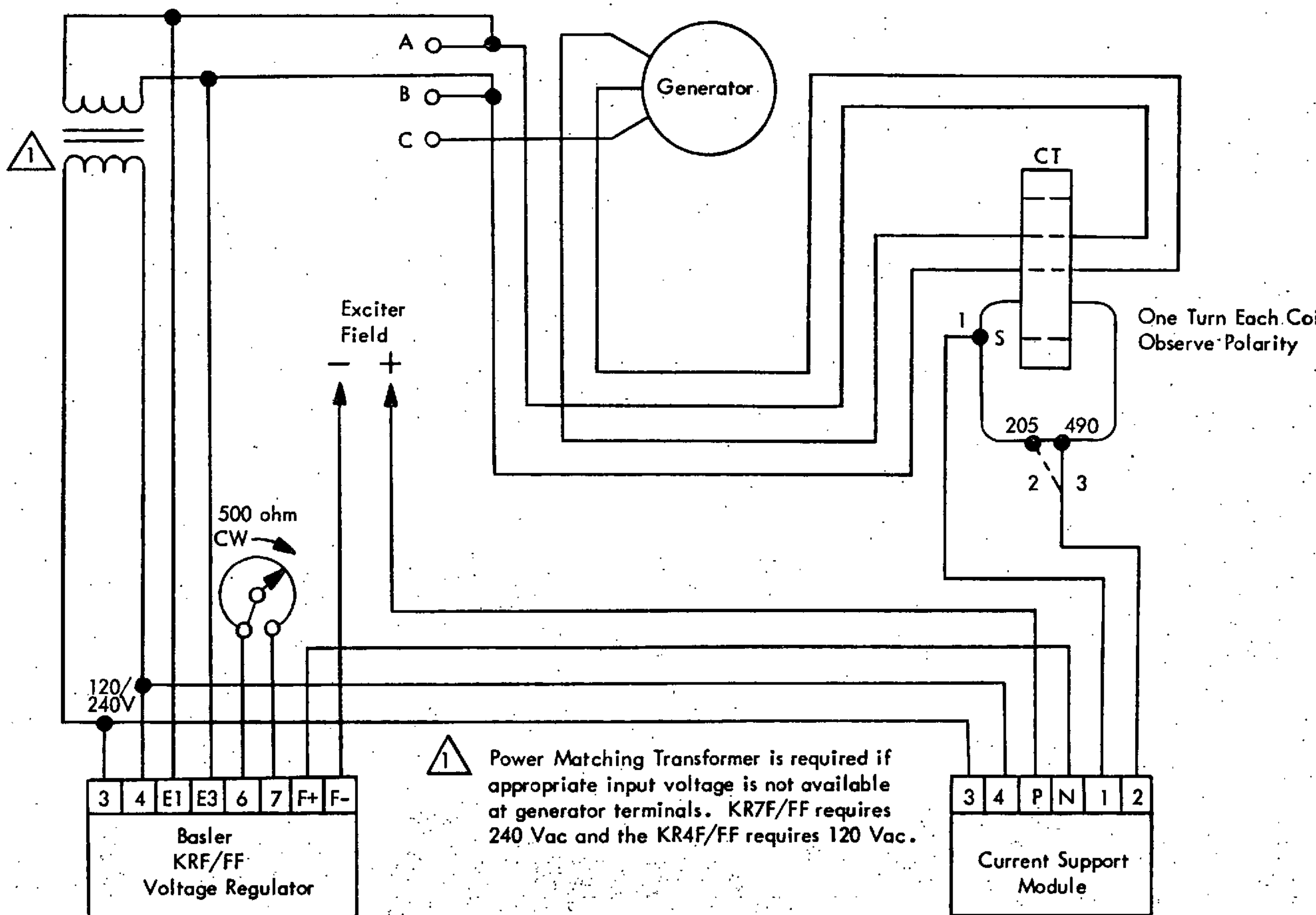
FIGURE 6-1 OUTLINE DRAWING



Numbers in parentheses indicate metric dimensions (millimeters).

FIGURE 6-2

CURRENT TRANSFORMER OUTLINE DRAWING (BE 15486 001)



1 Power Matching Transformer is required if appropriate input voltage is not available at generator terminals. KR7F/FF requires 240 Vac and the KR4F/FF requires 120 Vac.

FIGURE 6-3 INTERCONNECTION DIAGRAM FOR CBS 344/377 SYSTEMS