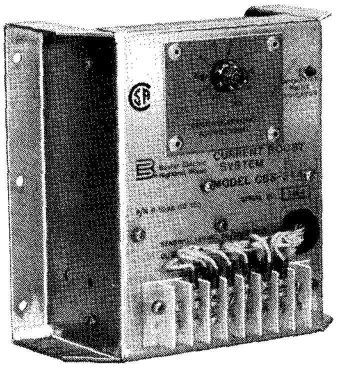
Class 300 Equipment

CBS 344, 377 CURRENT BOOST SYSTEMS



Current Boost Module

Current Transformer

FEATURES:

- Instantaneous response to system overloads and short circuits
- Output of 3.5A at 90Vdc (CBS 344) or 5A at 180Vdc (CBS 377)
- Actuated by generator voltage drop
- Adjustable operating voltage
- LED indicator for ease of adjustment
- Easy to apply
- For 50 and 60 Hz brushless generators
- Each model covers wide range of generator application
- Rugged construction
- Available from stock
- CSA approved

APPLICATIONS:

The CBS 344 and CBS 377 Current Boost Systems are electronic devices designed to provide Basler KR4 and KR7 series static voltage regulators with a power source in order to sustain exciter current when severe overloading of brushless generators occurs (such as heavy motor starting) or during short circuit conditions. Power for the current boost systems is derived from a power CT installed in two phases of the generator output. The Basler current boost systems allow coordinated protection schemes, having a basis of properly selected overcurrent trip points/time delay, to clear faulted circuits.

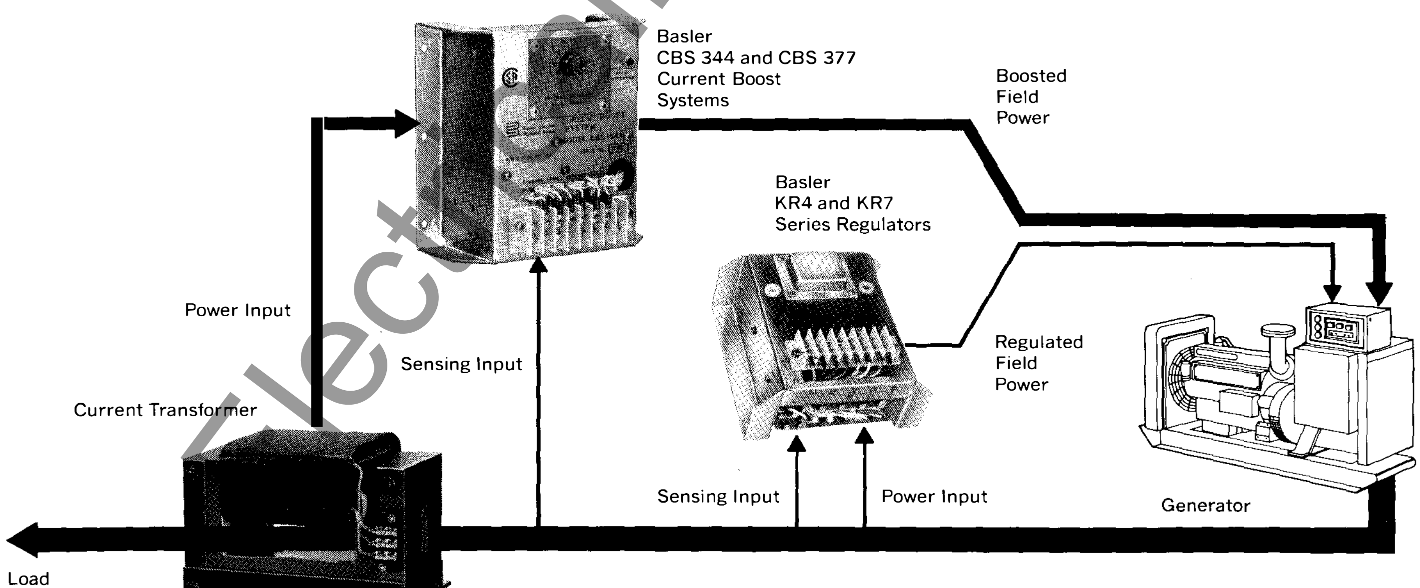


FIGURE 1 — APPLICATION DIAGRAM

Basler Electric

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SPW-3
12-85

DESCRIPTION:

The Current Boost System consists of a current boost module and a current transformer (CT). The system provides an alternate current source for a regulator, allowing the field to receive full forcing during severe generator overloading and short circuits.

The Current Boost System allows three wire and four wire generators to provide current during sustained single phase and multiple phase line-to-line faults. The CBS also permits 4 wire generators to support phase A and phase B line-to-neutral faults (excluding phase C line-to-neutral faults).

The current boost module utilizes generator output voltage sensing and comparison circuits to control dc output SCRs (turned on when generator operation is normal) which are supplied with current from a CT installed in two generator output lines. During overloads or short circuits, the CT is the main source of all excitation current for the generator — see Figures 2 and 3.

To verify that the available CTs will accommodate the generator's output cable, refer to "HOW TO ORDER" — Current Transformer".

Two CTs are available — a compact type (P/N BE 15486-001, see Figure 5) and one having a larger "window" (P/N BE 16866-001, see Figure 6). Electrical ratings and turns-ratios for both CTs are identical.

For generators with output voltage greater than 600V, safety requirements may not allow two output cables to pass through the "window" of the CT; a dual CT configuration utilizing identical CTs must then be used — see Figure 3.

SPECIFICATIONS:

DC OUTPUT POWER: (see Table 1)

AC SENSING VOLTAGE: (see Table 1)

DROPOUT RATIO: CBS 344: @ 5V above pick-up point
CBS 377: @ 10V above pick-up point

POWER DISSIPATION: Less than 50 watts at continuous rating.

OPERATING TEMPERATURE RANGE: −40°F (−40°C) to +140°F (+60°C)

STORAGE TEMPERATURE RANGE: −85°F (−65°C) to +185°F (+85°C)

SHOCK: Withstand up to 15 Gs in each direction

VIBRATION: Withstand the following vibration spectrum:

Frequency	Acceleration
5 - 26 Hz	1.2 G
26 - 52 Hz	0.036 in. displacement
52 - 260 Hz	5 G

FINISH: Chassis zinc coated per MIL-Z-325A, type II, class 2; circuit board epoxy conformal coated

WEIGHT:

CBS 344/CBS 377:	4.5 lbs. (2.03 kg) net	5.0 lbs. (2.27 kg) shipping
(CT) BE 15486-001:	32.4 lbs. (14.69 kg) net	35.0 lbs (15.9 kg) shipping
(CT) BE 16866-001:	52.0 lbs. (23.59 kg) net	53.0 lbs (24.0 kg) shipping

TABLE 1

Model	Use With	DC Output Power: DC Volts (Max.)	DC Output Power: DC Amps (Max.)	AC Sensing Voltage: Adjustment Range	AC Sensing Voltage: Burden
CBS 344	KR4 Series	90 Vdc	3.5A	70-131Vac	10VA
CBS 377	KR7 Series	180 Vdc	5.0A	140-262Vac	15VA

NOTES

⚠1 EACH GENERATOR CABLE (PRIMARY COIL) SHOULD ENTER AT OPPOSITE SIDE OF CT WINDOW.
OBSERVE POLARITY: BOTH PRIMARY COILS SHOULD HAVE EQUAL TURNS; REFER TO "HOW TO ORDER" FOR SELECTION OF CT TURNS RATIO.

⚠2 POWER ISOLATION TRANSFORMER

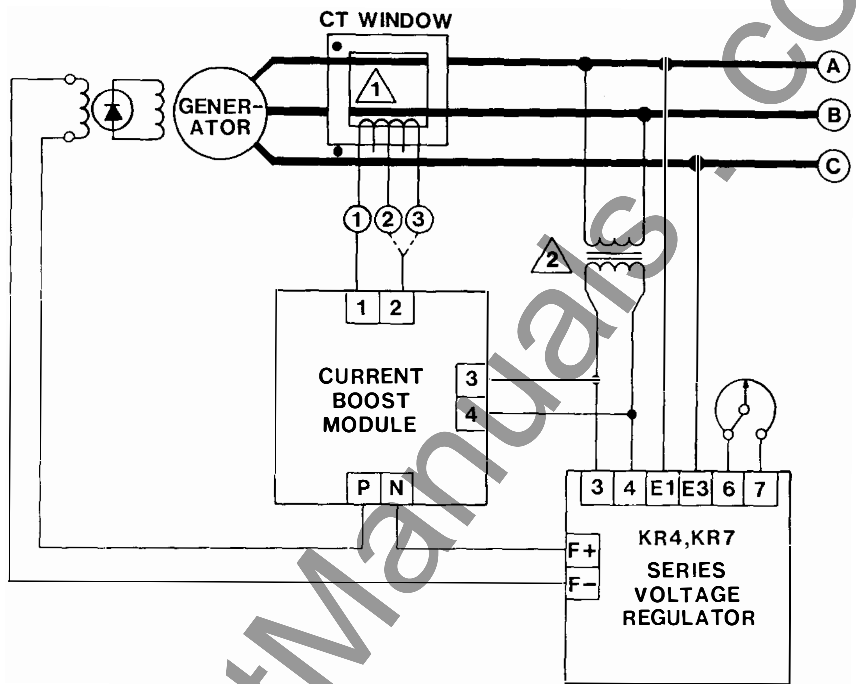


FIGURE 2 — INTERCONNECTION DIAGRAM, SINGLE CT

NOTES

⚠1 WITH SECONDARIES CONNECTED AS SHOWN, GENERATOR CABLE (PRIMARY COIL) ENTRY THROUGH CT 1 SHOULD BE OPPOSITE OF CABLE ENTRY THROUGH CT 2.
OBSERVE POLARITY: BOTH PRIMARY COILS SHOULD HAVE EQUAL TURNS; REFER TO "HOW TO ORDER" FOR SELECTION OF CT TURNS RATIO.

⚠2 POWER ISOLATION TRANSFORMER

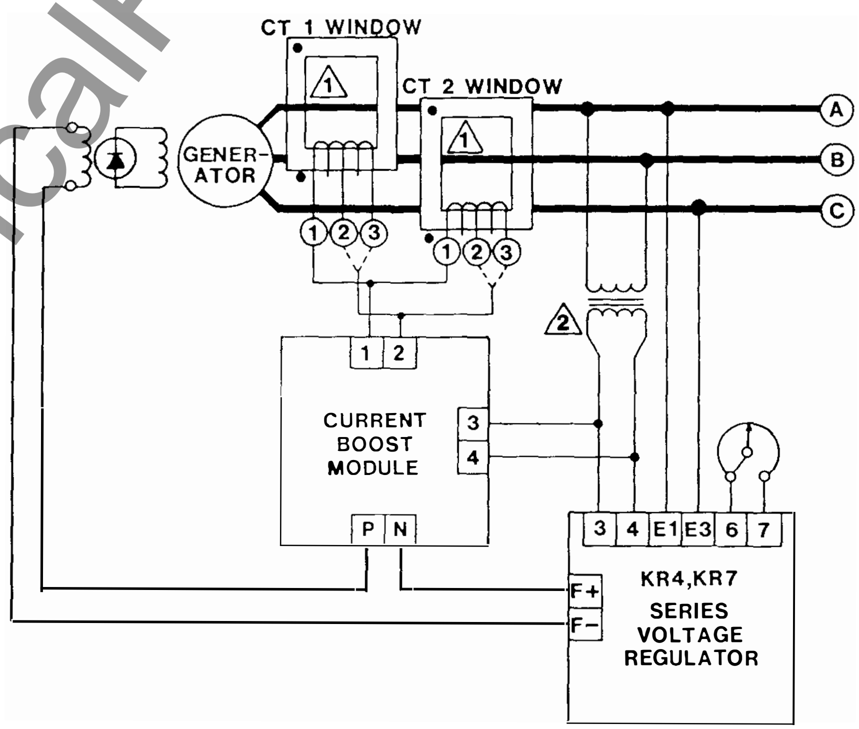


FIGURE 3 — INTERCONNECTION DIAGRAM, DUAL CTs

SAMPLE SPECIFICATION:

A current boost system shall be added to the output of a KR4F voltage regulator in order to sustain exciter field current of 3.5A at 90Vdc during severe generator output overloads. The operation point of this system shall be easily adjustable, and there shall be an indication when the sensed voltage drops below this point.

Power for the source shall be provided by a CT installed in two phases of the generator output.

The power source shall be Basler Electric Company Model CBS 344 Current Boost System, with CT P/N BE 15486-001.

HOW TO ORDER - Current Boost System:

WHEN THE CBS IS TO BE USED WITH	ORDER
KR4 Series Voltage Regulator	Current Boost System CBS 344
KR7 Series Voltage Regulator	Current Boost System CBS 377

HOW TO ORDER - Current Transformer (CT):

Follow the step-by-step procedure below to select the proper turns-ratio for your application. Based on the resulting turns-ratio and wire or bus size to be used for winding the required primary turns, determine the part number of the CT having the proper window size.

STEP 1: Calculate the exciter field current during a generator short circuit:

$$I_{Field} = \frac{E}{R}$$

where, I_{Field} = Exciter Field Current at Short Circuit
R = Exciter Field Resistance
E = CBS Field Forcing Voltage*

* 90Vdc Forcing Voltage for CBS 344
180Vdc Forcing Voltage for CBS 377

STEP 2: From short circuit saturation data (plot of exciter field current versus line amps with the output of the generator short circuited), available from the generator manufacturer, determine the generator three phase line current during a short circuit that would result from the exciter field current calculated in Step 1.

If	Then
This results in excessive generator line current	Proceed to step 3A
This results in acceptable generator line current	Proceed to step 3B

STEP 3A:

a. Determine the desired acceptable generator three phase line current at short circuit (typically 250-300% nominal). In Table 2, column 1, locate the number closest to this value.

b. Using short circuit saturation data (plot of exciter field current versus line amps with the output of the generator short circuited) from the generator manufacturer, determine the exciter field current at short circuit required to generate the acceptable generator line current*. In Table 2, column 2, locate the current value closest to this value.

* To obtain this reduced current, place a current limiting resistor in series with the exciter field — the value of this resistance is calculated as follows:

$$R_S = \frac{E}{I_2} - R_f$$

where, R_S = value of series field resistance to be added (ohms). (This resistance must not be so great as to restrict normal forcing).

E = exciter field forcing voltage (from step 1).

I_2 = field current required to produce acceptable generator line current at short circuit.

R_f = exciter field resistance.

c. Proceed to step 4.

STEP 3B:

a. In Table 2, column 1, locate the value of generator three phase line current at short circuit closest to the value determined in step 2.

b. In Table 2, column 2, locate the value of exciter field current at short current closest to the value determined in step 1.

c. Proceed to step 4.

STEP 4: Find the turns-ratio at the point of intersection of the values found in step 3A or 3B — if there is not a ratio at this point, use the ratio directly above the intersection.

The first numeral of the turns-ratio indicates the number of turns of each generator line that passes through the CT window. The second numeral indicates the number of secondary turns to be used.

NOTE - Increased CT power will result if a smaller turns-ratio is selected (CT primary turns are increased or CT secondary turns are decreased).

STEP 5: Multiply the first numeral of the turns-ratio by the number of conductors in each phase, then by the number of phases (2). Multiply this product by the diameter of the conductor to find the required minimum size of the CT window, then determine which of the CTs in Figures 5 and 6 meets the requirement. Figures 5 and 6 also show the appropriate CT terminals for secondary turns.

NOTE - If dual CTs are used, each CT receives the indicated primary turns from only one phase of the generator and each CT is connected using the indicated secondary turns.

TABLE 2 — TURNS-RATIO SELECTION (See Note "1", below)

	COLUMN 1	COLUMN 2							
	3 Phase Line Current at Short Circuit (Amperes)	Exciter Field Current at Short Circuit (Amperes) — KR4 And KR7 Series Voltage Regulators							
		2.5	2.8	3.15	3.54	4.0*	4.45*	5.0*	
	141	3:205		4:205		5:205		6:205	
	158		3:205		4:205		5:205		
	178	3:205		3:205		4:205		5.205	
	200		3:205		3:205		4:205		
	225	2:205		3:205		3:205		4.205	
	253		2.205		3:205		3:205		
	283	2:285		2:205		3:205		3:205	
	318		2.285		2:205		3:205		
	357	2:285		2:285		2:205		3:205	
	401		2.285		2:285		2:205		
	450	1:205		2:285		2:285		2:205	
	505		1:205		2:285		2:285		
	567	1:285		1:205		2:285		2:285	
	636		1:285		1:205		2:285		
	714	1:285		1:285		1:205		2:285	
	801		1:285		1:285		1:205		
	900	1:285		1:285		1:285		1:205	
	1010		1:285		1:285		1:285		
	1134	1:490		1:285		1:285		1:285	
	1273		1:490		1:285		1:285		
	1428	1:490		1:490		1:285		1:285	
	1603		1:490		1:490		1:285		
†	1800	1:490		1:490		1:490		1:285	
	2020		1:490		1:490		1:490		
††	2267	1:490		1:490		1:490		1:490	
	2547		1:490		1:490		1:490		
	2857			1:490		1:490		1:490	
	3207				1:490		1:490		
	3600					1:490		1:490	**
	4040						1:490		**
	4536							1:490	**

NOTE: (1) First number - primary (generator cable) turns for each phase.
Second number - secondary turns. If dual CTs are used, each CT receives the indicated primary turns from only one phase of the generator, and each CT is connected using the indicated secondary turns.

* KR7F only

** Only one phase connected to CT

† Example (Page 6) step 3A

†† Example (Page 6) step 3B

EXAMPLE

of the HOW TO ORDER — (CT) procedure on page 4

(STEP 1) Determine the exciter field current that will be provided by a Basler KR4F voltage regulator during short circuit:

$$I_F = \frac{E}{R} = \frac{90\text{Vdc}}{30\text{ ohms}} = 3.0\text{A}$$

where, I_F = Field current
E = Table 1, CBS 344/KR4 max. dc volts
R = Exciter field resistance

(STEP 2) From generator manufacturer data, you determine that the exciter field current of 3.0A from the KR4F voltage regulator would result in a short circuit line current of 2258A — for your generator system you consider this to be —

Excessive

Acceptable

(STEP 3A) (You determine that 1800A would constitute an acceptable generator line current at short circuit.) From generator manufacturer data, you determine that an exciter field current of 2.5A is required for the generator system to deliver an acceptable 1800A at short circuit.

Determine the necessary resistance to be added to the exciter field to achieve the 2.5A exciter field current.:

$$R_S = \frac{E}{I_2} - R_f = \frac{90\text{ Vdc}}{2.5\text{A}} - 30\text{ ohms} = 36 - 30\text{ ohms}$$

$$= 6\text{ ohms}$$

NOTE — The series resistance must not be so great as to restrict normal forcing.

In Table 2, column 1, the value of "1800A" corresponds with the required value of 1800A. Draw a horizontal line from this point across the chart.

In Table 2, column 2, the value of 2.5A corresponds with the required value of 2.5A (from step 3A). Draw a vertical line from this point down the chart.

(STEP 4) From Table 2, the intersection of the two lines from step 3A is the turns-ratio, 1:490:
1 turn on the primary
490 turns on the secondary

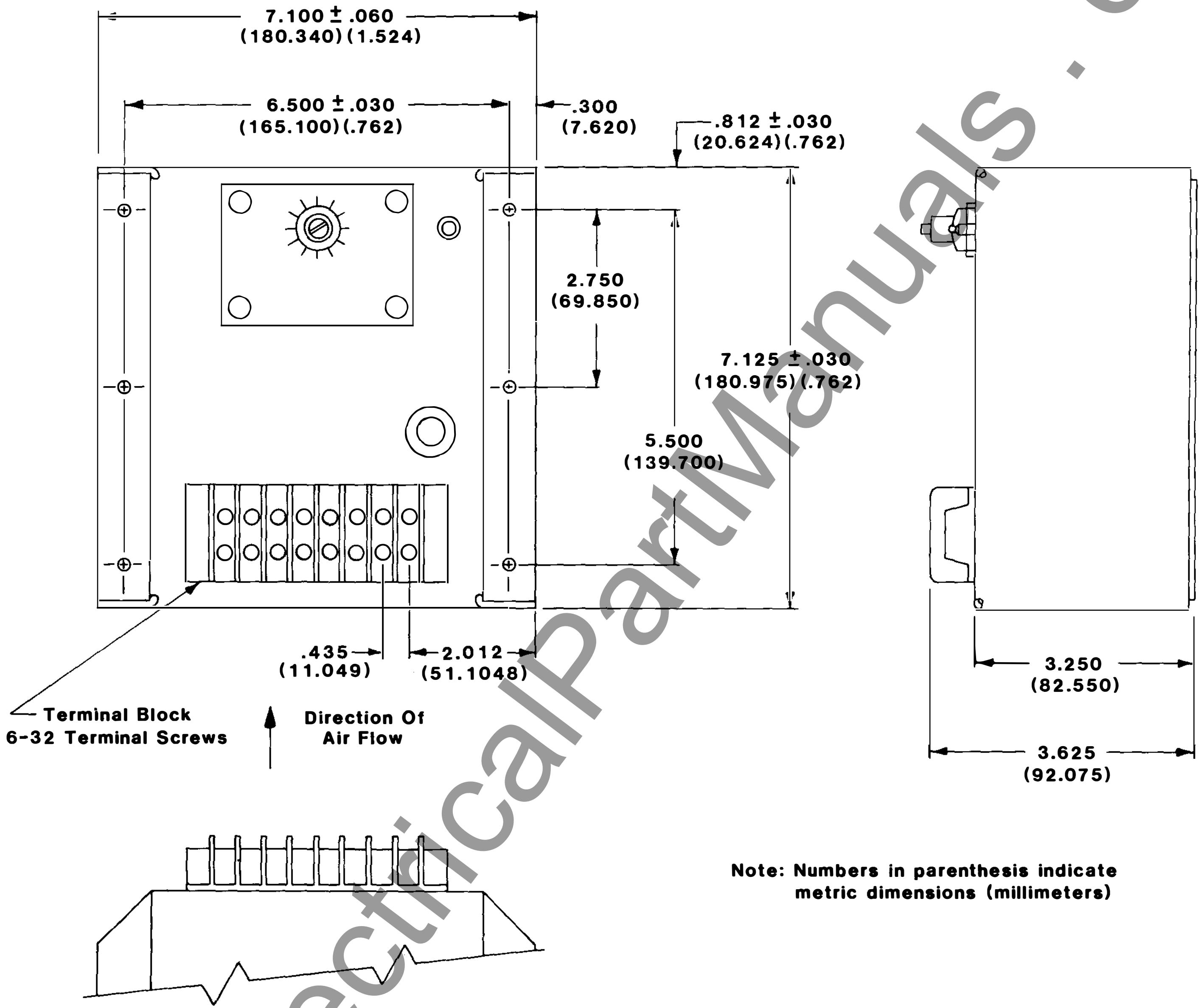
(STEP 5) The first numeral of the turns-ratio (1), the number of conductors per phase (2) and the number of phases (2) multiplied together results in: 4 conductors (through the CT window). From generator manufacturer data, 0.7 in. is the conductor diameter; therefore, for 4 conductors the CT window must be at least 0.7 in. x 2.8 in. Basler CT P/N BE 15486-001 (Figure 5) is 0.9 in. x 4.5 in. and meets the requirement.

(STEP 3B) In Table 2, column 1, the closest value to 2258A (from step 2) is "2267A". Draw a horizontal line from this point across the chart.

In Table 2, column 2, the closest value to 3.0A (from step 1) is "3.15A". Draw a vertical line from this point down the chart.

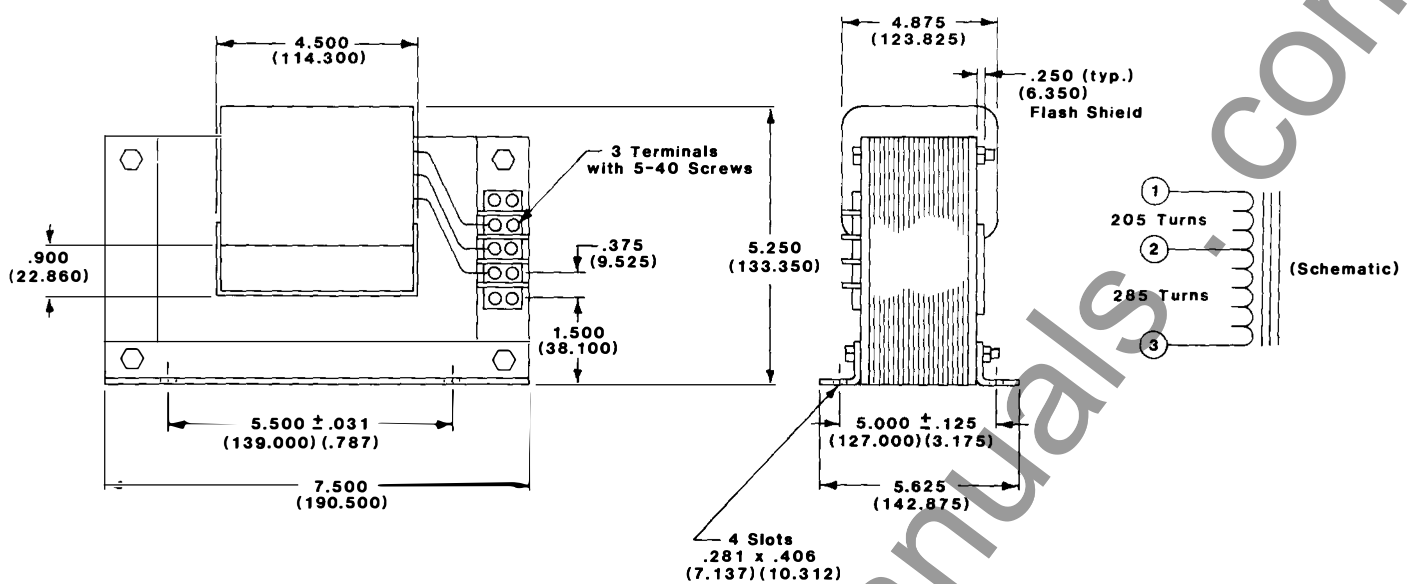
(STEP 4) From Table 2, the intersection of the two lines from step 3B is the turns-ratio, 1:490:
1 turn on the primary
490 turns on the secondary

(STEP 5) The first numeral of the turns-ratio (1), the number of conductors per phase (2) and the number of phases (2) multiplied together results in: 4 conductors (through the CT window). From generator manufacturer data, 0.7 in. is the conductor diameter; therefore, for 4 conductors the CT window must be at least 0.7 in. x 2.8 in. Basler CT P/N BE 15486-001 (Figure 5) is 0.9 in. x 4.5 in. and meets the requirement.



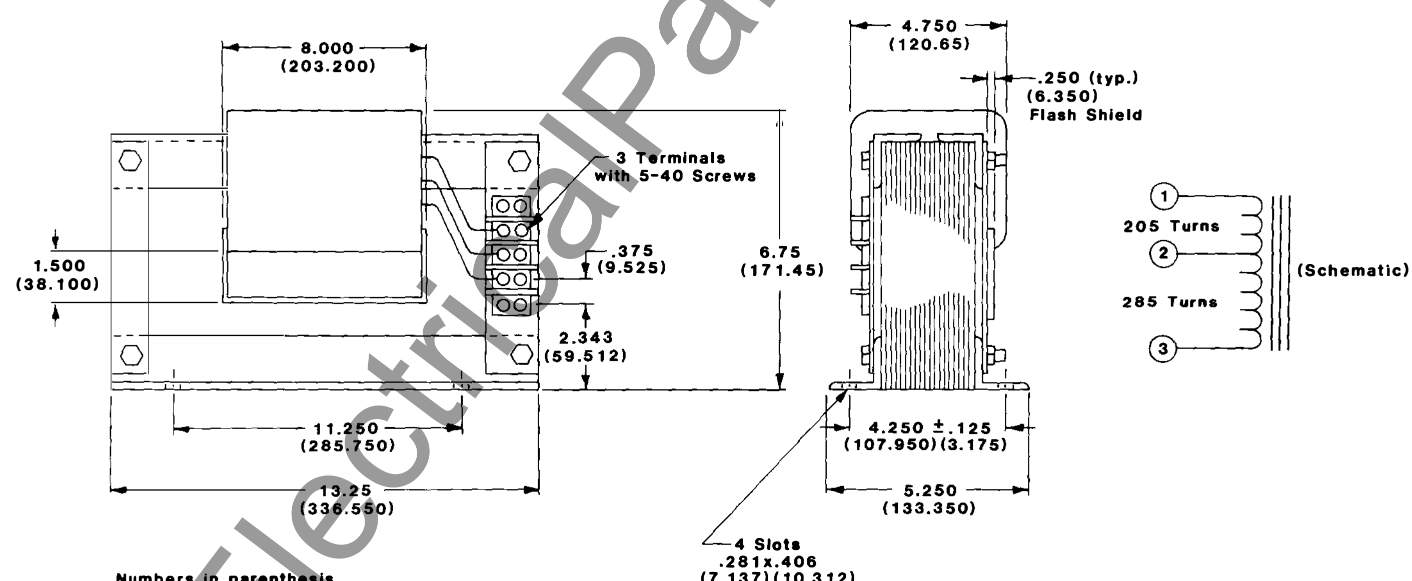
Note: Numbers in parenthesis indicate metric dimensions (millimeters)

FIGURE 4 — OUTLINE DRAWING, CURRENT BOOST MODULE
(CBS 344/CBS 377)



Numbers in parenthesis
indicate metric dimensions (millimeters)

FIGURE 5 — OUTLINE DRAWING, CURRENT TRANSFORMER, P/N BE 15486-001



Numbers in parenthesis
indicate metric dimensions (millimeters)

FIGURE 6 — OUTLINE DRAWING, CURRENT TRANSFORMER, P/N BE 16866-001

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