

## Design Choices

Sola/Hevi-Duty offers a broad range of industrial control solutions to the most demanding industrial applications. Our products exceed NEMA ratings for inrush and regulation to ensure control systems are powered correctly. Electromagnetic control components demand inrush currents up to 10 times the transformer's nominal rating. While this inrush is occurring, the output side of the transformer must not fall below 85% of nominal as specified by NEMA ST-1, Part 4. Using a transformer that does not meet these ratings may cause erroneous shutdowns of downstream processes.

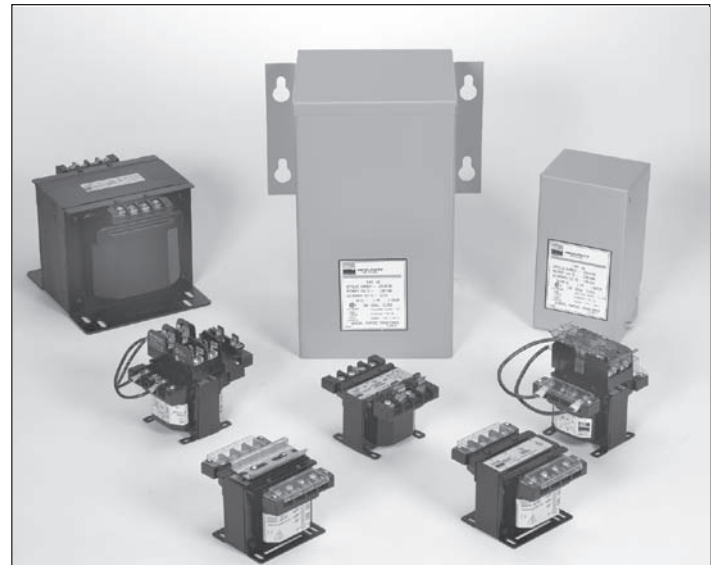
To meet your complete control needs, Sola/Hevi-Duty offers four series of control transformers, all of which exceed the NEMA standards. The Selection Chart can be used to identify the appropriate transformer for your application.

The **SBE series** is available from 50 - 5000 VA, 55°C rise and features copper windings and encapsulation (through 1000 VA) for longer life and protection from the environment. This low temperature performance can mean smaller cabinet size or longer life for any electronic components that may be nearby.

The **SMT series** are 115°C rise, aluminum wound and for applications where good voltage regulation and higher power capacities (1000-5000 VA) are required.

The **International series** meets IEC requirements and IP20 (touch proof covers ordered separately for E models) for European applications.

The **HSZ series** rounds out Hevi-Duty's line with an enclosed series of control transformers from 1 - 10 KVA that feature either an UL-3R, NEMA 4X or NEMA 4/12 enclosure. This unique design, featuring copper windings and encapsulated construction, can help system designers meet harsher environmental standards or design for a safer installation outside of a control cabinet. The HSZ series is for applications where cost or heat issues make mounting the transformer outside the control panel necessary.



## Sizing an Industrial Control Transformer

For proper transformer selection, three characteristics of the load circuit must be determined in addition to the minimum voltage required to operate the circuit. These are total steady state (sealed) VA, total inrush VA, and inrush load power factor.

- A. Sealed VA** - Total steady state sealed VA is the volt-amperes that the transformer must deliver to the load circuit for an extended period of time.
- B. Inrush VA** - Total inrush VA is the volt-amperes that the transformer must deliver upon initial energization of the control circuit. Energization of electromagnetic devices takes 30-50 milliseconds. During this inrush period the electromagnetic control devices draw many times normal current – 3-10 times normal is typical.
- C. Inrush Load Power Factor** is difficult to determine without detailed vector analysis of all the load components. Generally such an analysis is not feasible, therefore, a safe assumption is 40% power factor. Until recently 20% PF was commonly used for transformer calculations, however, tests conducted on major brands of control devices indicate that 40% PF is a safer default assumption.

## Selection Steps

1. Determine the supply and load voltages. The supply voltage is the available voltage to the control transformer. The load voltage is the operating voltage of the devices that will be connected to the transformer output.
2. Calculate the total sealed VA by adding the VA requirements of all components that will be energized together (timers, contactors, relays, solenoids, pilot lamps, etc.). Sealed VA data is available from the control device manufacturer.
3. Add the inrush VA of all components that will be energized together. Be sure to include the sealed VA of components that don't have an inrush, (lamps, timers, etc.) as they present a load to the transformer during maximum inrush.
4. Calculate selection inrush VA in one of the following two ways:

A. Selection inrush VA =

$$\sqrt{(VA \text{ sealed})^2 + (VA \text{ inrush})^2}$$

### Alternative Method

B. VA sealed + VA inrush = Selection inrush

Method B will result in a slightly oversized transformer.

5. If your line voltage varies 10% or more, contact **Technical Services** for assistance.
6. Utilizing the Regulation Data chart on pg. 234, select the transformer VA needed for your application from the "Transformer VA Rating" column. Check to be sure that the nameplate VA rating exceeds the sealed VA of the control circuit calculated in Step 1. If it does not, select a larger transformer VA that exceeds the circuit sealed VA.

By following the above procedure, the secondary voltage delivered by the transformer will be 90% of the nameplate secondary voltage under maximum inrush conditions at rated input voltage.

Now refer to the Selection Tables on the following pages for the style you have chosen. Select your transformer according to your required voltage and VA capacity.

Chart A: Voltage Code Chart

Voltage Code	Primary Voltage	Secondary Voltage	Hertz
None	240 x 480	120	60
	230 x 460	115	50/60
	220 x 440	110	50/60
A	240/480/600	120/99	50/60
	230/460/575	115/95	
D	240 x 480	24	60
E	120 x 240	24	60
JL	208/240/277	120/24	60
JN	208/240/480/600	120/24	60
	200/230/460/575	115/23	
R	480	240	50/60
TC	208/240/415	120 / - /24	50/60
	200/230/400	115/24/23	
	- /220/380	110/23/ -	
TE	208/240/415	24	50/60
	- / 277/480	24	60
	200/230/400	24	50/60
	- /220/380	23	50/60
TF	208/240/415/480/600*	120	50/60
	200/230/400/460/575*	115	50/60
	220/277*/380	110	50/60
TH	240/415/480	120/240	50/60
	230/400/460	115/230	50/60
	220/380/440	110/220	50/60
MH	208/240/415/480/600	120/240	50/60
	200/230/400/460/575	115/230	50/60
	- /220/380/440/550	110/220	50/60
MC	240/415/480	120 / - /24	50/60
	230/400/460	115/24/23	50/60
	220/380/440	110/23/ -	50/60

\* 60 Hz only.

Note: "-" indicated tap not used.

## Choosing the Correct Series

The **SBE** series of industrial control transformers provide voltage regulation which exceeds NEMA standards. The SBE series are a 55°C rise and have copper windings and are 50/60 Hz rated. The SBE series can handle significant inrush with a minimal drop in output voltage.

The **SMT** series are 115°C rise, aluminum wound and are for applications where good voltage regulation and higher power capacities are required.

The **International** series have multiple voltage taps for easy application. These units also meet IEC 61558-1, 61558-2-2 and are CE marked for easy export to European countries.

The **HSZ** series is for applications where cost or heat issues make mounting the transformer outside the control panel necessary. This series has 80°C rise and have copper winding for industrial applications. These units are enclosed with NEMA 3-R rating. Also available in NEMA 12, 4 and 4x.

## Selection Chart

VA	SBE ENCAPSULATED					SBE OPEN	SMT OPEN	HSZ* NEMA 3R		
	--	D	E	JL	JN	--	--	--	A	R
Temp	55°C					115°C		80°C		
50	E050	E050D	E050E	E050JL	E050JN					
75	E075		E075E							
100	E100	E100D	E100E	E100JL	E100JN					
150	E150		E150E		E150JN					
200	E200		E200E							
250	E250	E250D	E250E	E250JL	E250JN					
300	E300		E300E							
350	E350		E350E							
500	E500	E500D	E500E	E500JL	E500JN					
750	E750		E750E							
1000	E1000						T1000	HZ1000	HZ1000A	HZ1000R
1500						Y1500	T1500	HZ1500	HZ1500A	HZ1500R
2000						Y2000	T2000	HZ2000	HZ2000A	HZ2000R
3000						Y3000	T3000	HZ3000	HZ3000A	HZ3000R
5000						Y5000	T5000	HZ5000	HZ5000A	HZ5000R

\* Change HZxxxx to HZ12xxxx for NEMA 12 or 4 applications. For NEMA 4X, add 4X to end of part number.

## Selection Chart - International Series

VA	INTERNATIONAL SERIES ENCAPSULATED						
	TC	TE	TF	TH	TH	MH	MC
Temp	55°C				80°C		
50	E050TC	E050TE	E050TF	E050TH			
100	E100TC	E100TE	E100TF	E100TH			
150	E150TC	E150TE	E150TF	E150TH			
250	E250TC	E250TE	E250TF	E250TH			
500	E500TC	E500TE	E500TF	E500TH			
750			E750TF	E750TH			CE750MC
1000					CE1000TH	CE1000MH	CE1000MC
1500					CE1500TH	CE1500MH	CE1500MC
2000					CE2000TH	CE2000MH	

Note: Contact Technical Services for higher VA sizes of the MH and TH units.