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.

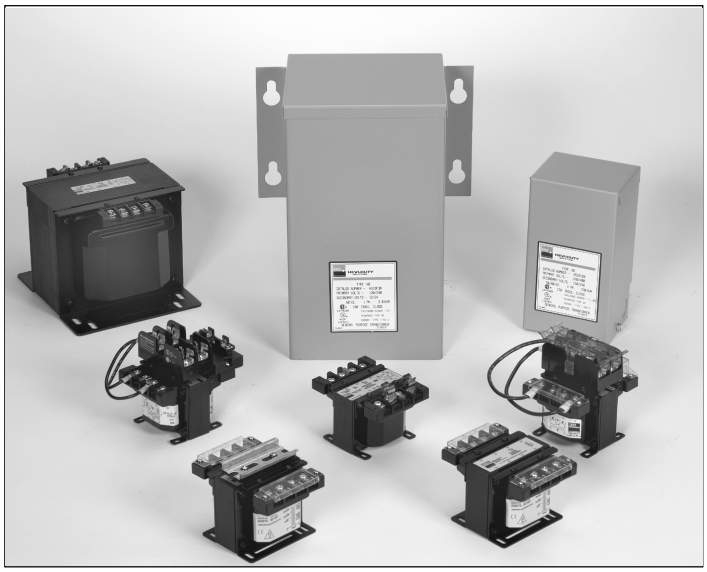
To meet your complete control needs, Sola/Hevi-Duty offers four series of control transformers, all of which exceed the NEMA standards. The Selection Chart can be used to identify the appropriate transformer for your application.

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 all IEC requirements including touchproof covers (IP20 ordered separately) for European applications.

The ***HSZ series*** rounds out Sola/Hevi-Duty's line with an enclosed series of control transformers from 1 - 10 KVA that feature either an UL-3R or NEMA 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 =

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

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. From Chart A, 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.

Chart A: Regulation Data – Inrush VA at 20% and 40% Power Factor

Selection Inrush VA*				Transformer VA Rating
Type SBE		Type SMT		
20% PF**	40% PF**	20% PF**	40% PF**	
294	207	N/A	N/A	50
515	363	N/A	N/A	75
696	490	N/A	N/A	100
1362	959	N/A	N/A	150
2131	1501	N/A	N/A	200
2883	2031	N/A	N/A	250
3608	2541	N/A	N/A	300
4777	3364	N/A	N/A	350
7601	5353	N/A	N/A	500
12939	9112	N/A	N/A	750
18703	13171	8277	5829	1000
23814	16066	17182	12100	1500
34586	24356	22834	16080	2000
45633	32770	34506	24300	3000
15800	111000	71284	50200	5000

** Assuming the transformer is to deliver a minimum of 90% secondary voltage during inrush conditions.*

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. 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.

You can also use our online transformer product selector at www.solaheviduty.com/select. Enter your voltage requirements, hit the submit button and the models that meet your requirements will be listed.

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.

Chart B: Voltage Code Chart

Voltage Code	Primary Voltage	Secondary Voltage
None	240 x 480	120
A	230/460/575	115/95
D	240 x 480	24
E	120 x 240	24
JL	208/240/277	120/24
JN	208/240/480/600	120/24
N	240/415/480/600	130/120/99
R	480	240
TC	208/240/415 200/230/400 220/380	120/24 115/24 110/23
TE	208/240/415 277/480 200/230/400 220/380	24 24 24 23
TF	208/240/415/480/600 200/230/400/460/575 220/277/380	120 115 110
TH	240/415/480 230/400/460 220/380/440	120/240 115/230 110/220

Selection Chart

VA	SBE							SMT			International Series				HSZ*		
	--	A	D	E	JL	JN	N	--	A	N	TC	TE	TF	TH	--	A	R
50	E050		E050D	E050E	E050JL	E050JN					E050TC	E050TE	E050TF	E050TH			
75	E075			E075E													
100	E100		E100D	E100E	E100JL	E100JN					E100TC	E100TE	E100TF	E100TH			
150	E150			E150E		E150JN					E150TC	E150TE	E150TF	E150TH			
200	E200			E200E													
250	E250		E250D	E250E	E250JL	E250JN					E250TC	E250TE	E250TF	E250TH			
300	E300			E300E													
350	E350			E350E													
500	E500		E500D	E500E	E500JL	E500JN					E500TC	E500TE	E500TF	E500TH			
750	E750			E750E									E750TF	E750TH			
1000	E1000						Y1000N			T1000N					HZ1000	HZ1000A	HZ1000R
1500	Y1500	Y1500A					Y1500N	T1500	T1500A	T1500N					HZ1500	HZ1500A	HZ1500R
2000	Y2000	Y2000A					Y2000N	T2000	T2000A	T2000N					HZ2000	HZ2000A	HZ2000R
3000	Y3000	Y3000A					Y3000N	T3000	T3000A	T3000N					HZ3000	HZ3000A	HZ3000R
5000	Y5000	Y5000A					Y5000N	T5000	T5000A	T5000N					HZ5000	HZ5000A	HZ5000R

** Part Numbers listed are NEMA 3R, for NEMA 12 change HZ to HZ12*