Design Choices

SolaHD offers a broad range of industrial control solutions for 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, SolaHD's 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.

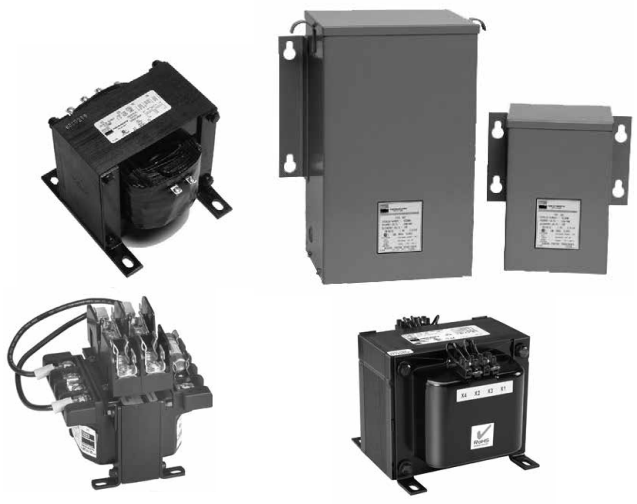
The **International series** meets IEC requirements and IP20 (touch proof covers ordered separately for E models) for European applications.

The **HSZ series** rounds out SolaHD's line with an enclosed series of control transformers from 1 - 10 kVA that feature either a UL Listed Type 3R, 4, 4X or 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.

SolaHD is pleased to offer custom transformers 1 kVA and larger. If you can't find what you are looking for here, we are happy to provide a quote on a custom transformer if available. Contact your local sales representative for more information.

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 (PF). 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 do not 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. Utilizing the regulation data chart below, 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.

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

Selection Inrush VA [1]				Transformer VA Rating
Type SBE		Type SMT		
20% PF [2]	40% PF [2]	20% PF [2]	40% PF [2]	
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
158000	111000	71284	50200	5000

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

[2] See *C. Inrush Load Power Factor* on page previous page.

Chart A: Voltage Code Chart

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

Note: "—" indicated tap not used.

* 60 Hz only at 277, 575 or 600 V.

Choosing the Correct Series

The **SBE** series of industrial control transformers provide voltage regulation which exceeds NEMA standards. They have 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 has copper winding for industrial applications. These units are enclosed with UL Listed/NEMA Type 3R enclosures. Also available in UL Listed/NEMA Type 4, 4X and 12.

Selection Chart

VA	SBE ENCAPSULATED					SBE OPEN (SZO)	SMT OPEN	HSZ * TYPE 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
75000								HZ75000	HZ75000A	HZ75000R
100000								HZ10000	HZ10000A	HZ10000R

* Change HZxxxx to HZ12xxxx for Type 12 or 4 applications or HZ4Xxxxx for Type 4X applications.

Selection Chart - International Series

VA	INTERNATIONAL SBE SERIES ENCAPSULATED				INTERNATIONAL SFP 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	

International Series Control Transformers: 50 - 750 VA

Electromagnetic control components demand inrush currents up to 10 times the transformers nominal rating without sacrificing secondary voltage stability beyond practical limits. The International series transformers fully comply with IEC and NEMA standards and are available with IEC touchproof covers (IP20).

Features

- Epoxy encapsulated for cooler operation
- Interleaved copper windings to reduce impedence
- 50/60 Hz
- 55°C Rise, 105°C insulation system for harsh, heavy duty applications
- Exceeds IEC, NEMA, ANSI, NMTBA, JIC and automotive standards

Certifications and Compliances

- c UL us Listed: E77014 - Type SBE
  - UL 5085-1, UL 5085-2
  - CSA C22.2 No. 66.1, No. 66.2
- CE - IEC/EN 61558-1, IEC/EN 61558-2-2
- RoHS Compliant

c UL us CE
E77014

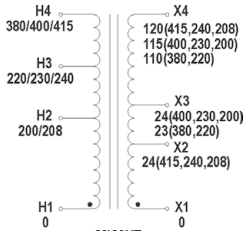
Related Products

- DIN Rail Power Supplies
- 63 Series Power Conditioners
- Surge Protective Devices

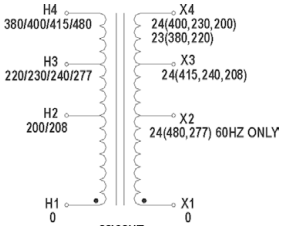
CATALOG NUMBER		FIELD INSTALLED OPTIONS DESCRIPTIONS
SBEDIN		**DIN Circuit Breaker Mounting** Field installed IEC fuse holder adaptor kit
IP20		**Terminal Covers (Two Covers Per Kit)** Field installed primary and secondary IEC Touch Proof Cover Kit.

Selection Tables: International Series

Group 1 – –/220/380 V Primary, 110/23 V Secondary, 50/60 Hz
208/240/415 V Primary, 120/24 V Secondary, 50/60 Hz
200/230/400 V Primary, 115/24 V Secondary, 50/60 Hz

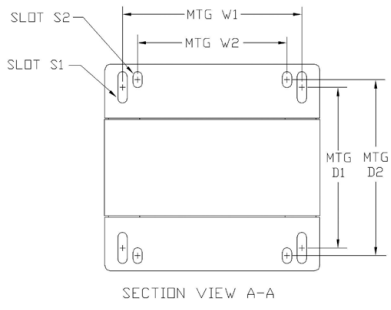
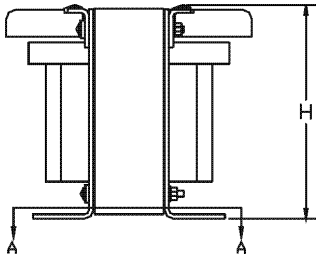
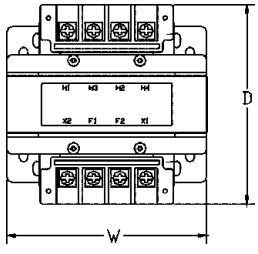
Continuous VA	Instantaneous VA	Catalog Number	Height in (mm)	Width in (mm)	Depth in (mm)	Mtg Width W1 / W2 – in (mm)	Mtg Depth D1 / D2 – in (mm)	Slot Size S1/S2 – in (mm)	Approx. Ship Weight lbs (kg)	
50	105	**E050TC**	2.96 (75.2)	3.39 (86.1)	4.36 (110.7)	2.81 / 2.50 (71.4 / 63.5)	2.10 / N/A (53.3 / N/A)	.20 x .50 / .20 x .50 (5.1 x 12.7 / 5.1 x 12.7)	4.0 (1.82)	
100	230	**E100TC**	3.89 (98.8)	4.50 (114.3)	4.48 (113.8)	3.74 / 3.12 (95.0 / 79.3)	2.56 / 2.87 (65.0 / 72.9)	.20 x .65 / .20 x .33 (5.1 x 16.5 / 5.1 x 8.4)	8.0 (3.67)	
150	420	**E150TC**	3.89 (98.8)	4.50 (114.3)	5.21 (132.3)	3.74 / 3.12 (95.0 / 79.3)	3.29 / 3.61 (83.6 / 91.7)	.20 x .65 / .20 x .33 (5.1 x 16.5 / 5.1 x 8.4)	11.0 (5.00)	
250	675	**E250TC**	4.53 (115.1)	5.25 (133.4)	5.07 (128.8)	4.38 / 3.75 (111.3 / 95.3)	3.54 / N/A (89.9 / N/A)	.31 x .85 / .31 x .85 (7.9 x 21.6 / 7.87 x 21.6	15.0 (6.82)	
500	1550	**E500TC**	5.56 (141.2)	6.38 (162.1)	6.93 (176.0)	5.32 / 4.37 (135.1 / 111.0)	4.25 / 5.75 (108.0 / 146.1)	.31 x .03 / .31 x .85 (7.9 x .85 / 7.9 x 21.6)	30.0 (13.64)	

Group 2 – 208/240/415 V Primary, 24 V Secondary, 50/60 Hz
277/480 V Primary, 24 V Secondary, 60 Hz
200/230/400 V Primary, 24 V Secondary, 50/60 Hz
220/380 V Primary, 23 V Secondary, 50/60 Hz

Continuous VA	Instantaneous VA	Catalog Number	Height in (mm)	Width in (mm)	Depth in (mm)	Mtg Width W1 / W2 in (mm)	Mtg Depth D1 / D2 in (mm)	Slot Size S1/S2 – in (mm)	Approx. Ship Weight lbs (kg)	
50	105	**E050TE**	2.96 (75.2)	3.39 (86.1)	4.36 (110.7)	2.81 / 2.50 (71.4 / 63.5)	2.10 / N/A (53.3 / N/A)	.20 x .50 / .20 x .50 (5.1 x 12.7 / 5.1 x 12.7)	4.0 (1.82)	
100	230	**E100TE**	3.89 (98.8)	4.50 (114.3)	4.48 (113.8)	3.74 / 3.12 (95.0 / 79.3)	2.56 / 2.87 (65.0 / 72.9)	.20 x .03 / .20 x .01 (5.1 x .65 / 5.1 x .33)	8.0 (3.67)	
150	420	**E150TE**	3.89 (98.8)	4.50 (114.3)	5.21 (132.3)	3.74 / 3.12 (95.0 / 79.3)	3.29 / 3.61 (83.6 / 91.7)	.20 x .03 / .20 x .01 (5.1 x .65 / 5.1 x .33)	11.0 (5.00)	
250	700	**E250TE**	4.53 (115.1)	5.25 (133.4)	5.07 (128.8)	4.38 / 3.75 (111.3 / 95.3)	3.54 / N/A (89.9 / N/A)	.30 x .71 / .30 x .71 (7.9 x 18.0 / 7.9 x 18.0)	15.0 (6.82)	
500	1550	**E500TE**	5.56 (141.2)	6.38 (162.1)	6.93 (176.0)	5.32 / 4.37 (135.1 / 111.0)	4.25 / 5.75 (108.0 / 146.1)	.30 x .85 / .30 x .85 (7.9 x 21.6 / 7.9 x 21.6)	30.0 (13.64)	

Note: Instantaneous VA calculated at At 50% PF (Power Factor), 95% Nominal Secondary Voltage.

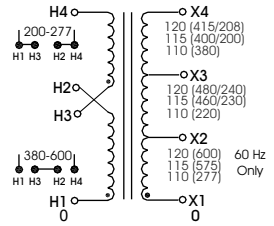
Design Style

Mounting Dimensions	Profile	Top View
		

Selection Tables: International Series - continued

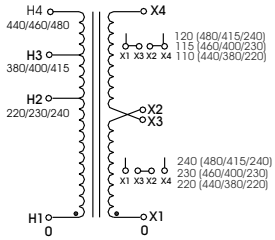
Group 3 – 208/240/415/480/600 V Primary, 120 V Secondary, 50/60 Hz
200/230/400/460/575 V Primary, 115 V Secondary, 50/60 Hz
220/277 /380 V Primary, 110 V Secondary, 50/60 Hz
Note: 277V, 575V, 600V taps are 60Hz only.

Continuous VA	Instantaneous VA	Catalog Number	Height in (mm)	Width in (mm)	Depth in (mm)	Mtg Width W1 / W2 – in (mm)	Mtg Depth D1 / D2 – in (mm)	Slot Size S1/S2 – in (mm)	Approx. Ship Weight lbs (kg)
50	93	**E050TF**	2.96 (75.2)	3.39 (86.1)	4.36 (110.7)	2.81 / 2.50 (71.4 / 63.5)	2.10 / N/A (53.3 / N/A)	.20 x .50 / .20 x .50 (5.1 x 12.7 / 5.1 x 12.7)	4.0 (1.82)
100	205	**E100TF**	3.89 (98.8)	4.50 (114.3)	4.48 (113.8)	3.74 / 3.12 (95.0 / 79.3)	2.56 / 2.87 (65.0 / 73.0)	.20 x .65 / .20 x .33 (5.1 x 16.5 / 5.1 x 8.4)	8.0 (3.67)
150	390	**E150TF**	3.89 (98.8)	4.50 (114.3)	5.21 (132.3)	3.74 / 3.12 (95.0 / 79.3)	3.29 / 3.61 (83.6 / 91.7)	.20 x .65 / .20 x .33 (5.1 x 16.5 / 5.1 x 8.4)	11.0 (5.00)
250	630	**E250TF**	4.53 (115.1)	5.25 (133.4)	5.07 (128.8)	4.38 / 3.75 (111.3 / 95.3)	3.54 / N/A (89.9 / N/A)	.31 x .71 / .31 x .71 (7.9 x 18.0 / 7.9 x 18.0)	15.0 (6.82)
500	1200	**E500TF**	5.56 (141.2)	6.38 (162.1)	6.93 (176.0)	5.32 / 4.37 (135.1 / 111.0)	4.25 / 5.75 (108.0 / 146.1)	.31 x .85 / .31 x .85 (7.9 x 21.6 / 7.9 x 21.6)	30.0 (13.64)
750	2290	**E750TF**	5.56 (141.2)	6.38 (162.1)	7.36 (187.0)	5.32 / 4.37 (135.1 / 111.0)	4.68 / 6.18 (118.9 / 157.0)	.31 x .85 / .31 x .85 (7.9 x 21.6 / 7.9 x 21.6)	34.0 (15.45)



Group 4 – 240/415/480 V Primary, 120/240 V Secondary, 50/60 Hz
230/400/460 V Primary, 115/230 V Secondary, 50/60 Hz
220/380/440 V Primary, 110/220 V Secondary, 50/60 Hz

Continuous VA	Instantaneous VA	Catalog Number	Height in (mm)	Width in (mm)	Depth in (mm)	Mtg Width W1 / W2 in (mm)	Mtg Depth D1 / D2 in (mm)	Slot Size S1/S2 – in (mm)	Approx. Ship Weight lbs (kg)
50	110	**E050TH**	2.96 (75.2)	3.39 (86.1)	4.36 (110.7)	2.81 / 2.50 (71.4 / 63.5)	2.10 / N/A (53.3 / N/A)	.20 x .50 / .20 x .50 (5.1 x 12.7 / 5.1 x 12.7)	4.0 (1.82)
100	235	**E100TH**	3.89 (98.8)	4.50 (114.3)	4.48 (113.8)	3.74 / 3.12 (95.0 / 79.3)	2.56 / 2.87 (65.0 / 73.0)	.20 x .65 / .20 x .33 (5.1 x 16.5 / 5.1 x 8.4)	8.0 (3.67)
150	470	**E150TH**	3.89 (98.8)	4.50 (114.3)	5.21 (132.3)	3.74 / 3.12 (95.0 / 79.3)	3.29 / 3.61 (83.6 / 91.7)	.20 x .65 / .20 x .33 (5.1 x 16.5 / 5.1 x 8.4)	11.0 (5.00)
250	730	**E250TH**	4.53 (115.1)	5.25 (133.4)	5.07 (128.8)	4.38 / 3.75 (111.3 / 95.3)	3.54 / N/A (89.9 / N/A)	.31 x .81 / .31 x .85 (7.9 x 20.6 / 7.9 x 18.0)	15.0 (6.82)
500	1550	**E500TH**	5.56 (141.2)	6.38 (162.1)	6.93 (176.0)	5.32 / 4.37 (135.1 / 111.0)	4.25 / 5.75 (108.0 / 146.1)	.31 x .85 / .31 x .85 (7.9 x 21.6 / 7.9 x 21.6)	30.0 (13.64)
750	2250	**E750TH**	5.56 (141.2)	6.38 (162.1)	7.36 (187.0)	5.32 / 4.37 (135.1 / 111.0)	4.68 / 6.18 (118.9 / 157.0)	.31 x .85 / .31 x .85 (7.9 x 21.6 / 7.9 x 21.6)	34.0 (15.45)



Note: Instantaneous VA calculated at At 50% PF (Power Factor), 95% Nominal Secondary Voltage.

International Series - Fuse Recommendations

Primary Fusing: Consult local electrical code. Secondary Fusing: per IEC/EN61558-2-2.

VA	Maximum Current Rating of Fuse		
	24 Vac	115 Vac	230 Vac
50	2	0.5	0.25
100	4	1	0.5
150	6	1.6	0.8
250	10	2.5	1.25
500	20	5	2.5
750	20	6.3	3.15