

Hammond Transformers

**Imperator****Fortress****Spartan**

Get years of reliable service from a quality transformer at a practical price

HPS Imperator™ control transformers for industrial applications

HPS Imperator control transformers from Hammond are designed for high inrush applications requiring reliable output voltage stability. Designed for industrial applications where electromagnetic devices such as relays, solenoids, etc. are used, they maximize inrush capability and output voltage regulation when electromagnetic devices are initially energized.

HPS Imperator control transformers use Mylar, Nomex and other high-quality insulating materials to electrically insulate turn-to-turn windings, layer-to-layer windings, primary-to-secondary windings and ground. These transformers are vacuum impregnated with VT polyester resin and oven-cured, which seals the surface and eliminates moisture. Filling the entire unit provides a strong mechanical bond and offers protection from the environment. This design utilizes superior insulation systems and is constructed with high quality silicon steel laminations, which provide optimum performance and reliability.

The custom injection-molded cover, with its unique fin-shaped design, provides excellent cooling properties while protecting the coils and terminations from moisture, dirt and other industrial airborne contaminants.

The heavy steel mounting feet are welded to the core, providing maximum strength and low noise in a compact design.

The HPS Imperator's unique terminal block design (patent pending) allows for the quick and easy installation of standard secondary or optional primary 13/32" x 1 1/2" midget/type CC fuse clips on every unit. This is the simplest and most inexpensive fusing installation provided on any industrial control transformer in the market today.

The windings and internal terminations of the HPS Imperator are encapsulated, which protects them from moisture, dirt and other airborne contaminants. The custom molded coil covers with their unique fin-shaped design combine superior transformer cooling properties with a clean bold look.

The HPS Imperator utilizes custom serrated terminals in combination with standard SEMS washer screws for easier assembly and quicker installation as well as superior connection strength when connecting with bare, solid, or stranded wire. It also allows for ring or spade termination connectors with a maximum width of 0.37 in (9.4 mm).

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HPS Fortress™ commercial potted transformers

The HPS Fortress commercial potted transformers provide an innovative design with commercial applications where quality, ease of installation, and low cost are key.

All Fortress units are encapsulated with electrical grade silica sand and resin compounds, which completely enclose the core and coil to seal out moisture, airborne contaminants and eliminates corrosion and deterioration.

HPS Spartan™ open core and coil control transformers

The HPS Spartan line of industrial open-style control transformers is ideally suited for general purpose, industrial and light duty loads.

Designed for applications with lower inrush and where less demanding environmental protections are needed, HPS Spartan models offer an efficient and economical solution. They feature molded terminal blocks up to 3000VA or 30A. Optional finger guards and a fuse block adapter kit are available.

Superior quality and value

- Compact, efficient design
- Easy installation and hook-up
- Inexpensive while maintaining superior quality in materials and workmanship
- Wall mounting

Applications

- Lighting
- Motor control circuits
- HVAC
- Signal and alarm systems
- Circuit isolation
- Schools
- Office buildings

HPS Imperator™ Control Transformer Selection



To select the proper transformer, you must first determine three characteristics of the load circuit. They are: total steady-state (sealed) VA, total inrush VA, and inrush load power factor.

Total steady-state "sealed" VA is the total amount of VA that the transformer must supply to the load circuit for an extended length of time. Calculate by adding the total steady-state VA of all devices in your control circuit. (The operating VA data for the devices should be available from the manufacturers.)

The inrush VA is the amount of VA that the transformer must supply for all components in the control circuit that are energized together. Consideration for the start-up sequence may be required. (Inrush VA data should be obtained from the device manufacturers.)

The inrush load power factor is difficult to determine without detailed vector analysis of all the control components. In the absence of such information, we recommend that a 40% power factor be utilized.

Six easy steps

Once the three load circuit variables have been determined, follow these steps to select the proper transformer.

1. Determine your primary (supply) and secondary (output) voltage requirements, as well as the required frequency (i.e. 60 Hz).
2. Calculate the total sealed VA of your circuit by adding the total sealed VA of all devices in the control circuit.
3. Calculate the inrush VA by adding the inrush VA of all components being energized together. Remember to add the sealed VA of all components that do not have inrush VA (lamps, timers, etc.), as they do present a load to the transformer during maximum inrush. If the inrush for your components is unknown, assume a 40% inrush power factor.
4. Calculate the total inrush VA using one of two methods as shown below. **Method B will result in selection of a slightly larger transformer.**

A **Total Inrush VA=**

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

or

B **Total Inrush VA=**
VA Sealed + VA Inrush

5. If the nominal supply voltage does not fluctuate more than 5%, reference the 90% secondary voltage column in the Regulation Data Table for the correct VA rating.

If the supply voltage varies up to 10%, the 95% secondary voltage column should be used to size the transformer. The 85% secondary voltage column gives minimum values for proper electromagnetic device operation and should only be used as a reference.

HPS Imperator Transformer Regulation Data Table

Continuous VA Transformer Nameplate	Inrush VA @ 40% Power Factor		
	85% Secondary Voltage	90% Secondary Voltage	95% Secondary Voltage
50	330	259	192
75	350	258	170
100	620	467	321
150	895	699	512
250	1596	1229	880
350	2464	1889	1345
500	3939	2854	1819
750	6422	4778	3228
1000	9842	7102	4530
1500	12797	9018	5489

Note: It is recommended that a control transformer be sized at a 40% power factor. Some components in a circuit, such as electromagnetic devices, typically operate at that level due to their inherently lower power factor. Selecting a transformer at 40% power factor will more than adequately size the unit for all the various loads in the circuit.

6. Using the regulation data table below, select the appropriate VA rated transformer:
 - A. With a continuous VA rating that is equal to or greater than the value in Step 2.
 - B. With a maximum inrush VA equal to or greater than the value obtained in Step 4.

Note: See over-current protection chart for transformers at the end of this section.

Voltage regulation in transformers

Voltage regulation in transformers is the difference between the "No-Load voltage" and the "Full-Load voltage." This is expressed in terms of percentage.

$$\text{Regulation Percentage} = \frac{E_{\text{No-Load}} - E_{\text{Full Load}}}{E_{\text{Full Load}}} (100\%)$$

The secondary voltages (nominal) listed in these pages are at Full-Load, meaning the point at which the transformer is operating at maximum permissible secondary current. No-Load voltage can increase 4 to 6%.

Warning:

Secondary voltages of transformers may damage some loads. For example, a transformer connected as 480/120 Volt but applied 495 Volt primary can produce at No-Load a voltage of 134 Volts which will damage the inputs of a PLC [D0-06AA](#), whose maximum input voltage is 132 Volt. Notice that the current of [D0-06AA](#) input is 10mA, making it very close to No-Load.

Recommendations for Overcurrent Protection UL and CSA (North American) Standards

UL and CSA (North American) Standards

North American standards, including UL 508, National Electric Code 450, and the Canadian Electrical Code, Part 1, require overcurrent protection on all control circuit transformers. There are two options for overcurrent protection:

Option 1 (Primary only Protection)

Provide an overcurrent device in the primary circuit rated to the current of the transformer. The overcurrent limits are as follows:

- Primary 9 Amps or more: no more than 125% of rated current
- Primary 2 to 9 Amps: no more than 167% of rated current
- Primary less than 2 Amps: no more than 300% of rated current for power circuits; no more than 500% of rated current for control circuits

Note: This method is considered less desirable, as start-up inrush to the transformer can frequently surpass the current rating of the device and result in nuisance interruptions.

Option 2 (Primary and Secondary Protection)

The second option is to install overcurrent devices in both the primary and secondary circuits of the transformer. In this option, the secondary device must be rated no more than 125% of rated current of the transformer and the primary no more than 250%. The Canadian Electrical Code permits 300% overcurrent on the primary for this option.

In both options listed, it is recommended that time delay fuses be considered to avoid unnecessary interruptions.

REFERENCES:

UL 508
UL 845
NEC 430-72
NEC 450-3
CEC Part 1, 26-256

Recommendations for Overcurrent Protection UL and CSA (North American) Standards, continued

PRIMARY (UL and CSA)

To assist in the selection of fuses, the following chart recommends the maximum primary fuse rating in amperes. The first number shown is the maximum overcurrent protection when the primary current is less than 2 amps and the overcurrent protection device is rated for 300%. The second number (shown in brackets) is recommended when the primary is less than 2 amps and the overcurrent device is to be rated at 500% of rated current. Where only one number is indicated, the primary is 2 amps or more and one rating of overcurrent protection is shown as optimal. Choose the next higher fuse rating if these numbers do not correspond with standard fuse selections.

HCTR Current Limiting Class CC Fuses				
Part Number	AMP Rating	Pcs/Pkg	Weight	Price
HCTR-25	0.25	10/1	0.2 lb	\$;00efk:
HCTR-5	0.5	10/1	0.2 lb	\$;00eft:
HCTR-75	0.75	10/1	0.2 lb	\$;00efv:
HCTR1	1	10/1	0.2 lb	\$;00efc:
HCTR1-25	1.25	10/1	0.2 lb	\$;00efe:
HCTR1-5	1.5	10/1	0.2 lb	\$;00efg:
HCTR2	2	10/1	0.2 lb	\$;00efh:
HCTR2-5	2.5	10/1	0.2 lb	\$;00efi:
HCTR3	3	10/1	0.2 lb	\$;00efn:
HCTR3-5	3.5	10/1	0.2 lb	\$;00efp:
HCTR4	4	10/1	0.2 lb	\$;00efq:
HCTR5	5	10/1	0.2 lb	\$;00efs:
HCTR6	6	10/1	0.2 lb	\$;00efu:
HCTR7-5	7.5	10/1	0.2 lb	\$;00efx:
HCTR8	8	10/1	0.2 lb	\$;00efy:
HCTR10	10	10/1	0.2 lb	\$;00efd:
HCTR15	15	10/1	0.2 lb	\$;00eff:
HCTR20	20	10/1	0.2 lb	\$;00efi:
HCTR25	25	10/1	0.2 lb	\$;00efj:
HCTR30	30	10/1	0.2 lb	\$;00efo:

Note: See HCTR fuse catalog page for characteristic curves.

Recommended Maximum Primary Fuse Ratings in Amps Where Primary Current is less than 2 Amps.

Primary Voltage	Overload Protection	Hammond Transformers VA RATING												
		50	75	100	150	250	350	500	750	1000	1500	2000	3000	5000
115	300%	1.25	1.8	2.5	3.5	4.0	5.0	8.0	10.0	15.0	20.0	25.0	–	–
	500%	[2.0]	[3.2]	[4.0]	[6.5]	–	–	–	–	–	–	–	–	–
120	300%	1.25	1.8	2.25	3.5	4.0	5.0	8.0	10.0	15.0	15.0	20.0	–	–
	500%	[2.0]	[3.2]	[4.0]	[6.5]	–	–	–	–	–	–	–	–	–
220	300%	0.6	1.0	1.25	2.0	3.2	4.5	4.0	6.0	8.0	12.0	15.0	20.0	30.0
	500%	[1.125]	[1.6]	[2.25]	[3.2]	[5.6]	[7.5]	–	–	–	–	–	–	–
208	300%	0.6	1.0	1.4	2.0	3.5	5.0	4.0	6.0	8.0	12.0	15.0	20.0	30.0
	500%	[1.125]	[1.8]	[2.25]	[3.5]	[6.0]	[8.0]	–	–	–	–	–	–	–
230	300%	0.6	0.8	1.25	1.8	3.2	4.5	4.0	6.0	8.0	10.0	15.0	20.0	30.0
	500%	[1.0]	[1.6]	[2.0]	[3.2]	[5.0]	[7.5]	–	–	–	–	–	–	–
240	300%	0.6	0.8	1.25	1.8	3.0	4.0	3.5	5.0	7.0	10.0	15.0	15.0	30.0
	500%	[1.0]	[1.5]	[2.0]	[3.0]	[5.0]	[7.0]	–	–	–	–	–	–	–
277	300%	0.5	0.8	1.0	1.6	2.5	3.5	5.0	5.0	6.0	9.0	12.0	15.0	25.0
	500%	[0.8]	[1.25]	[1.8]	[4.5]	[6.25]	[9.0]	–	–	–	–	–	–	–
380	300%	0.3	0.5	0.75	1.125	1.8	2.5	3.5	5.6	4.5	6.25	9.0	15.0	20.0
	500%	[0.6]	[0.8]	[1.25]	[1.8]	[3.2]	[4.5]	[6.25]	[9.0]	–	–	–	–	–
440	300%	0.3	0.5	0.6	1.0	1.6	2.25	3.2	5.0	4.0	6.0	8.0	12.0	15.0
	500%	[0.5]	[0.8]	[1.125]	[1.6]	[2.8]	[3.5]	[5.6]	[8.0]	–	–	–	–	–
460	300%	0.3	0.4	0.6	0.8	1.6	2.25	3.2	4.5	3.5	6.0	8.0	12.0	15.0
	500%	[0.5]	[0.8]	[1.0]	[1.6]	[2.5]	[3.5]	[5.0]	[8.0]	–	–	–	–	–
480	300%	0.3	0.4	0.6	0.8	1.5	2.0	3.0	4.5	3.5	5.0	7.0	10.0	15.0
	500%	[0.5]	[0.75]	[1.0]	[1.5]	[2.5]	[3.5]	[5.0]	[7.5]	–	–	–	–	–

Recommendations for Overcurrent Protection UL and CSA (North American) Standards, continued

SECONDARY

The overcurrent protection listed below, in amperes, is 125% of the rated current of the transformer. Choose the next higher fuse rating if these numbers do not correspond with standard fuse selections.

MEN General Purpose Midget Class Fuses				
Part Number	AMP Rating	Pcs/Pkg	Weight	Price
<u>MEN-5</u>	0.5	10/1	0.2 lb	\$0eg7:
<u>MEN-6</u>	0.6	10/1	0.2 lb	\$0eg9:
<u>MEN1</u>	1	10/1	0.2 lb	\$.0efz:
<u>MEN1-4</u>	1.4	10/1	0.2 lb	\$.00ef_:
<u>MEN1-5</u>	1.5	10/1	0.2 lb	\$.;00ef!:
<u>MEN2</u>	2	10/1	0.2 lb	\$.0ef?:
<u>MEN2-5</u>	2.5	10/1	0.2 lb	\$0eg1:
<u>MEN3</u>	3	10/1	0.2 lb	\$0eg2:
<u>MEN3-5</u>	3.5	10/1	0.2 lb	\$0eg4:
<u>MEN4</u>	4	10/1	0.2 lb	\$0eg5:
<u>MEN5</u>	5	10/1	0.2 lb	\$0eg6:
<u>MEN6</u>	6	10/1	0.2 lb	\$0eg8:
<u>MEN7</u>	7	10/1	0.2 lb	\$0ega:
<u>MEN8</u>	8	10/1	0.2 lb	\$0egb:
<u>MEN10</u>	10	10/1	0.2 lb	\$.;0ef]:
<u>MEN12</u>	12	10/1	0.2 lb	\$.;0ef]:
<u>MEN15</u>	15	10/1	0.2 lb	\$.0ef#:
<u>MEN20</u>	20	10/1	0.2 lb	\$.;0ef,:
<u>MEN25</u>	25	10/1	0.2 lb	\$0eg0:
<u>MEN30</u>	30	10/1	0.2 lb	\$0eg3:

Note: See MEN fuse catalog page for characteristic curves.

Recommended Maximum Secondary Fuse Ratings in Amps.

Secondary Voltage	Overload Protection	Hammond Transformers VA RATING												
		50	75	100	150	250	350	500	750	1000	1500	2000	3000	5000
12	125%	5.3	7.9	11.0	16.0	27.0	–	–	–	–	–	–	–	–
24	125%	2.7	4.0	5.3	7.9	14.0	19.0	27.0	–	–	–	–	–	–
110	125%	0.6	0.9	1.2	1.8	2.9	4.0	5.7	8.6	12.0	18.0	23.0	–	–
115	125%	0.6	0.9	1.1	1.7	2.8	3.9	5.5	8.2	11.0	17.0	22.0	–	–
120	125%	0.6	0.8	1.1	1.6	2.7	3.7	5.3	7.9	11.0	16.0	21.0	–	–
220	125%	0.3	0.5	0.6	0.9	1.5	2.0	2.9	4.3	5.7	8.6	12.0	18.0	29.0
230	125%	0.3	0.5	0.6	0.9	1.4	2.0	2.8	4.1	5.5	8.2	11.0	17.0	28.0