

# Hammond Control Transformers



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 specifically designed for high inrush applications requiring reliable output voltage stability. Designed to meet 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.

## Superior quality and design

HPS Imperator control transformers use Mylar, Nomex and other high-quality insulating materials. Insulation is used 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

## 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:

$$A \quad \text{Total Inrush VA} = \sqrt{(\text{VA sealed})^2 + (\text{VA inrush})^2}$$

or

$$B \quad \text{Total Inrush VA} = \text{VA Sealed} + \text{VA Inrush}$$

**Method B will result in slightly larger transformer selected.**

5. If the nominal supply voltage does not fluctuate more than 5%, then 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.
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.*

**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.*

# HPS Imperator™ 240x480 / 120x240 VAC Control Transformers Specifications

## Features

- 600V class, machine tool rated industrial control transformers
- 50/60 Hertz
- VA range from 50 VA up to 1500 VA
- Constructed with high quality silicon steel laminations that provide optimum performance and reliability
- Encapsulated coils, encased in a custom injection molded cover, protect coils and terminations from moisture, dirt and other industrial airborne contaminants.

- Terminated with #8/32 slot/Phillips terminal screws complete with SEMS washer (suitable for 18 AWG to 14 AWG solid or 14 AWG stranded wire)
- Insulation system:
  - 50 - 150VA, temperature rise 55°C (131°F), insulation class 105°C (221°F),
  - 250 - 1500VA, temperature rise 80°C (176°F), insulation class 130°C (266°F)
- SEMS (standard machine screw with lock washer) standard
- **Standard secondary fuse kits utilizing 13/32" x 1 1/2" midget class CC fuse clips included with all transformers.**

**Fuses are not included. (see Edison fuse section for HCTR fuses.)**

- **Optional primary fuse kits available utilizing 13/32" x 1 1/2" midget class CC fuse clips**
- Optional finger-safe terminal covers
- LIFETIME warranty (limited to mfg. defects)

## Agency Approvals

- UL Listed (approved for U.S. and Canada) File E50394
- CE Mark standard on all units
- RoHS Compliant

HPS Imperator 240x480/120x240 Control Transformer Specifications									
Part Number	Wt/Lbs	Volt-Amp Rating*	Mtg. Fig.	Output Current Amps	Primary Voltage (50/60Hz)	Secondary Voltage	Impedance %		Total Heat Dissipation (Watts)**
							VA	%z	
PH50MQMJ	3.50	50	A	0.42/0.21	240x480 230x460 220x440	120x240 115x230 110x220	50	8.3	11
PH75MQMJ	3.54	75	A	0.63/0.31			75	8.7	14
PH100MQMJ	4.50	100	A	0.83/0.42			100	8.4	14
PH150MQMJ	5.70	150	B	1.25/0.63			150	8.0	18
PH250MQMJ	7.50	250	B	2.08/1.04			250	7.8	29
PH350MQMJ	10.1	350	B	2.92/1.46			350	7.0	33
PH500MQMJ	14.2	500	B	4.17/2.08			500	5.0	40
PH750MQMJ	16.6	750	B	6.25/3.13			750	4.9	54
PH1000MQMJ	23.6	1000	B	8.33/4.17			1000	3.9	69
PH1500MQMJ	34.0	1500	B	12.5/6.25			1500	3.9	101

Note: \*VA capacity rated at the output of the transformer.  
 \*\* Heat dissipation calculated based on full rated load on transformer.



## Dimensions

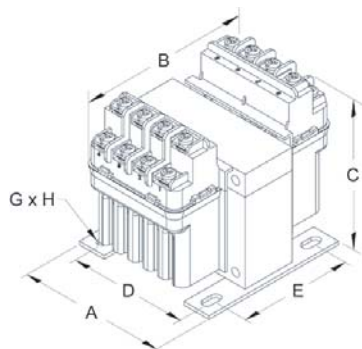


FIGURE A (100 VA and less)

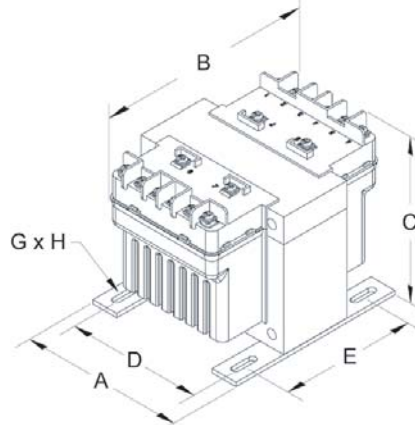


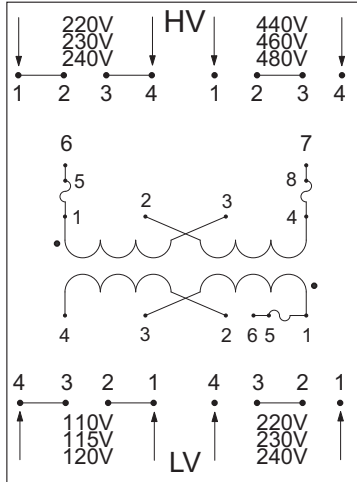
FIGURE B (150 VA to 1500 VA)

HPS Imperator 240x480/120x240 Control Transformer Dimensions								
Part Number	Overall Dimensions inches (mm)			Mounting Centers inches (mm)		Mounting Slot inches (mm)	Height with Finger Guard inches (mm)	Depth with Finger Guard inches (mm)
	A	B	C	D	E	G x H		
PH50MQMJ	3.00 (76.2)	4.38 (111.3)	3.19 (81.0)	2.50 (63.5)	2.25 (57.2)	0.22 x 0.44 (5.6 x 11.2)	4.00 (101.6)	5.82 (147.8)
PH75MQMJ	3.25 (82.6)	3.88 (98.5)	3.56 (90.4)	2.63 (66.8)	2.50 (63.5)	0.22 x 0.44 (5.6 x 11.2)	4.37 (111.0)	5.32 (135.1)
PH100MQMJ	3.25 (82.6)	4.19 (106.4)	3.63 (92.2)	2.63 (66.8)	2.63 (66.8)	0.22 x 0.44 (5.6 x 11.2)	4.44 (112.8)	5.63 (143.0)
PH150MQMJ	4.00 (101.6)	4.94 (125.5)	3.81 (96.8)	3.38 (85.9)	2.75 (69.9)	0.22 x 0.75 (5.6 x 19.1)	4.31 (109.5)	6.44 (163.6)
PH250MQMJ	4.50 (114.3)	5.44 (138.2)	3.81 (96.8)	3.75 (95.3)	3.13 (79.5)	0.22 x 0.75 (5.6 x 19.1)	4.31 (109.5)	6.94 (176.3)
PH350MQMJ	4.50 (114.3)	5.19 (131.8)	4.44 (112.8)	3.75 (95.3)	3.75 (95.3)	0.22 x 0.75 (5.6 x 19.1)	4.94 (125.5)	6.69 (169.9)
PH500MQMJ	4.75 (120.7)	5.94 (150.9)	4.31 (109.5)	4.06 (103.1)	3.81 (96.8)	0.31 x 0.94 (7.9 x 23.9)	4.81 (122.2)	7.44 (189.0)
PH750MQMJ	5.13 (130.3)	6.69 (169.9)	4.31 (109.5)	4.38 (111.3)	4.31 (109.5)	0.31 x 0.81 (7.9 x 20.6)	4.81 (122.2)	8.19 (208.1)
PH1000MQMJ	5.25 (133.4)	6.81 (173.0)	4.94 (125.5)	4.50 (114.3)	4.44 (112.8)	0.31 x 0.81 (7.9 x 20.6)	5.44 (138.2)	8.31 (211.1)
PH1500MQMJ	5.25 (133.4)	8.19 (208.0)	4.94 (125.5)	4.50 (114.3)	6.06 (153.9)	0.38 x 1.00 (9.7 x 25.4)	5.44 (138.2)	9.69 (246.1)

Note: All dimensions are ±0.06 inches unless otherwise noted.

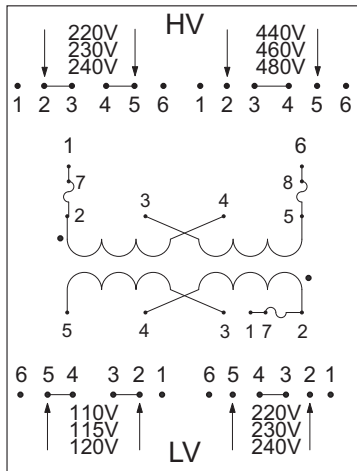
# HPS Imperator™ 240x480 / 120x240 VAC Control Transformers Wiring Specifications

## Wiring



**PH\*\*\*MQMJ Schematic for 50, 75 and 100VA Units**

High Voltage (HV) (Primary Volts)	Install Supplied Links Between Terminals	Supply Lines Connect To	Install Fuse Clips To
240 230 220	1-2, 3-4	1, 4	Unfused
480 460 440	2-3	1, 4	Unfused
240 230 220	1-2, 3-4	6, 7	1-5, 4-8
480 460 440	2-3	6, 7	1-5, 4-8
Low Voltage (LV) (Secondary Volts)	Install Supplied Links Between Terminals	Load Lines Connect To	Install Fuse Clips To
120 115 110	3-4, 1-2	1, 4	Unfused
240 230 220	2-3	1, 4	Unfused
120 115 110	3-4, 1-2	4, 6	1-5
240 230 220	2-3	4, 6	1-5



**PH\*\*\*MQMJ Schematic for 150VA to 1500VA Units**

High Voltage (HV) (Primary Volts)	Install Supplied Links Between Terminals	Supply Lines Connect To	Install Fuse Clips To
240 230 220	2-3, 4-5	2, 5	Unfused
480 460 440	3-4	2, 5	Unfused
240 230 220	2-3, 4-5	1, 6	2-7, 5-8
480 460 440	3-4	1, 6	2-7, 5-8
Low Voltage (LV) (Secondary Volts)	Install Supplied Links Between Terminals	Load Lines Connect To	Install Fuse Clips To
120 115 110	4-5, 2-3	2, 5	Unfused
240 230 220	3-4	2, 5	Unfused
120 115 110	4-5, 2-3	1, 5	2-7
240 230 220	3-4	1, 5	2-7

**Notes**

1. FUSES NOT INCLUDED (see Edison fuse section for HCTR fuses).
2. Secondary fuse clips supplied but not installed. Order fuses and primary fuse clips separately.
3. Jumper links to make primary/secondary series/parallel connections supplied, but not installed.

# HPS Imperator™ Transformers

## Accessories – Terminal Covers and Fuse Kits

### Finger-safe terminal covers

These one-piece molded terminal covers are a quick and easy way to provide safety and protection in the workplace. They protect operators from potential shock hazards and guard against accidental contact with the fuses.



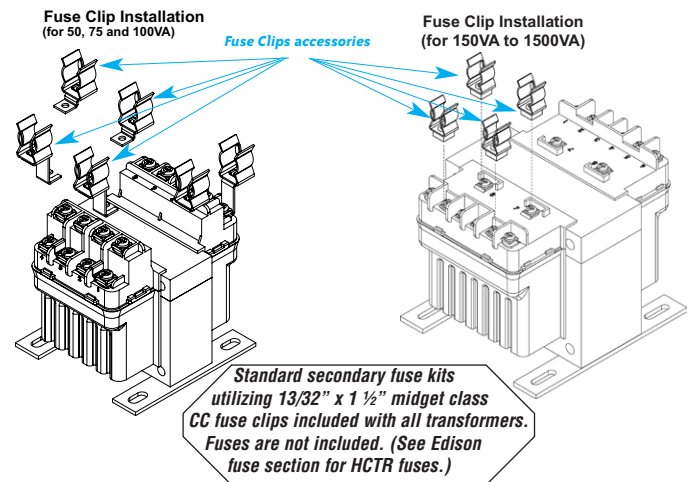
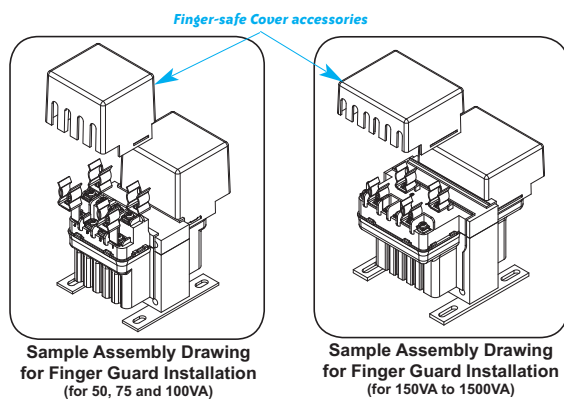
### Fuse Kits

These optional primary side fuse kits contain four fuse clips, four mounting screws, and complete instructions.

The table below makes it easy to choose the correct terminal covers and fuse kits for your Hammond control transformer.



Transformer	Finger-Safe Terminal Covers			Primary Side Fuse Kits	
Part Number	Part Number	Pcs/Pkg	Description.	Part Number	Pcs/Pkg
PH50MQMJ PH50PG	FG1	1 cover	Finger-safe cover for 50VA <b>unfused</b> control transformers. Cover fits primary side or secondary side.	PFK1	4 fuse clips, 4 mounting screws
	FGF1	1 cover	Finger-safe cover for 50VA <b>fused</b> control transformers. Cover fits primary side or secondary side.		
PH75MQMJ PH75PG	FG2	1 cover	Finger-safe cover for 75VA and 100VA <b>unfused</b> control transformers. Cover fits primary side or secondary side.		
PH75MQMJ PH75PG PH100MQMJ PH100PG	FGF2	1 cover	Finger-safe cover for 75VA and 100VA <b>fused</b> control transformers. Cover fits primary side or secondary side.		
PH150MQMJ PH150PG PH250MQMJ PH250PG	FG3	1 cover	Finger-safe cover for 150VA and 250VA <b>fused</b> and <b>unfused</b> control transformers. Cover fits primary side or secondary side.		
PH350MQMJ PH350PG PH500MQMJ PH500PG PH750MQMJ	FG4	1 cover	Finger-safe cover for 350VA and 500VA <b>fused</b> and <b>unfused</b> control transformers. Also for use with PH750MQMJ. Cover fits primary side or secondary side.	PFK3	4 fuse clips, 4 mounting screws
PH750PG PH1000MQMJ PH1000PG PH1500MQMJ	FG5	1 cover	Finger-safe cover for 750VA (PH750PG only), 1kVA and 1.5kVA <b>fused</b> and <b>unfused</b> control transformers. Cover fits primary side or secondary side.		4 fuse clips, 4 mounting screws



1. Torque all terminal screws between 12 and 14 in-lbs.
2. For all bare wire connections, the recommended wire size range is 18 AWG to 14 AWG for solid wire, and 14 AWG for stranded. A ring or spade connector must be used if using a wire size outside the range listed above.
3. Ensure mounting screws used for transformer installation (not supplied) are properly sized for transformer weight.
4. When mounting fuse clips, remove the appropriate captive washer screw(s) from terminal block and install fuse clip(s) and new terminal screw(s).
5. Please refer to wiring instructions included with the Hammond control transformer for connection details.

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

PLC  
OverviewDL05/06  
PLCDL105  
PLCDL205  
PLCDL305  
PLCDL405  
PLC

Field I/O

Software

C-more  
HMIs

Other HMI

AC Drives

Motors

Steppers/  
ServosMotor  
ControlsProximity  
SensorsPhoto  
SensorsLimit  
Switches

Encoders

Current  
SensorsPushbuttons/  
Lights

Process

Relays/  
Timers

Comm.

TB's &  
Wiring

Power

Circuit  
Protection

Enclosures

Appendix

Part Index

## 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.

**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
115	300%	1.25	1.8	2.5	3.5	4.0	5.0	8.0	10.0	15.0	20.0
	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
	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
	500%	(1.125)	(1.6)	(2.25)	(3.2)	(5.6)	(7.5)	—	—	—	—
230	300%	0.6	0.8	1.25	1.8	3.2	4.5	4.0	6.0	8.0	10.0
	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
	500%	(1.0)	(1.5)	(2.0)	(3.0)	(5.0)	(7.0)	—	—	—	—
440	300%	0.3	0.5	0.6	1.0	1.6	2.25	3.2	5.0	4.0	6.0
	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
	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
	500%	(0.5)	(0.75)	(1.0)	(1.5)	(2.5)	(3.5)	(5.0)	(7.5)	—	—

## 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.

**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
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%	0.75	1.125	1.5	2.25	3.5	5.0	7.5	10.0	15.0	18.0
115	125%	0.6	1.0	1.4	2.0	3.0	5.0	7.0	10.0	15.0	17.0
120	125%	0.6	1.0	1.25	2.0	3.2	4.5	6.25	10.0	15.0	16.0
220	125%	0.3	0.5	0.6	0.9	1.5	2.0	2.9	4.3	5.7	8.6
230	125%	0.3	0.5	0.6	0.9	1.4	2.0	2.8	4.1	5.5	8.2

HCTR Current Limiting Class CC Fuses			
Part Number	AMP Rating	Pcs/Pkg	Weight
HCTR-25	0.25	10/1	0.2 lb
HCTR-5	0.5	10/1	0.2 lb
HCTR-75	0.75	10/1	0.2 lb
HCTR1	1	10/1	0.2 lb
HCTR1-25	1.25	10/1	0.2 lb
HCTR1-5	1.5	10/1	0.2 lb
HCTR2	2	10/1	0.2 lb
HCTR2-5	2.5	10/1	0.2 lb
HCTR3	3	10/1	0.2 lb
HCTR3-5	3.5	10/1	0.2 lb
HCTR4	4	10/1	0.2 lb
HCTR5	5	10/1	0.2 lb
HCTR6	6	10/1	0.2 lb
HCTR7-5	7.5	10/1	0.2 lb
HCTR8	8	10/1	0.2 lb
HCTR10	10	10/1	0.2 lb
HCTR15	15	10/1	0.2 lb
HCTR20	20	10/1	0.2 lb
HCTR25	25	10/1	0.2 lb
HCTR30	30	10/1	0.2 lb

Note: See HCTR fuse catalog page for characteristic curves.

MEN General Purpose Midget Class Fuses			
Part Number	AMP Rating	Pcs/Pkg	Weight
MEN-5	0.5	10/1	0.2 lb
MEN-6	0.6	10/1	0.2 lb
MEN1	1	10/1	0.2 lb
MEN1-4	1.4	10/1	0.2 lb
MEN1-5	1.5	10/1	0.2 lb
MEN2	2	10/1	0.2 lb
MEN2-5	2.5	10/1	0.2 lb
MEN3	3	10/1	0.2 lb
MEN3-5	3.5	10/1	0.2 lb
MEN4	4	10/1	0.2 lb
MEN5	5	10/1	0.2 lb
MEN6	6	10/1	0.2 lb
MEN7	7	10/1	0.2 lb
MEN8	8	10/1	0.2 lb
MEN10	10	10/1	0.2 lb
MEN12	12	10/1	0.2 lb
MEN15	15	10/1	0.2 lb
MEN20	20	10/1	0.2 lb
MEN25	25	10/1	0.2 lb
MEN30	30	10/1	0.2 lb

Note: See MEN fuse catalog page for characteristic curves.