EATON | Cutler-Hammer

IT. 24V DC Power Supplies

Application Note

Electromechanical Contactors and Starters

Why is 24V DC control power becoming more prevalent in industry? There are several main drivers — safety concerns, reduction in product size and cost, functionality and reliability improvement, and the growing availability of 24V DC products such as sensors, instrumentation systems, PLC I/O, and other signal, conditioning and power control devices.

This application note is intended to help in the selection of the proper 24V DC power supply, by taking into account the continuous (sealed) and inrush (peak) current or wattage demands of multiple devices, when connected to a single 24V DC power supply.

The characteristics of interest for the available Cutler-Hammer ***IT.*** 24V DC power supplies are shown in the following table.

Table 1. 24V DC Power Supplies

Catalog Number	Continuous (Sealed)		Inrush (Peak)		Input Voltage VAC
	Wattage	Amperes	Wattage	Amperes	
PSS10E	10	0.4	20	0.8	90 – 260
PSS25E	25	1.0	165	6.5	90 – 260
PSS10F	10	0.4	20	0.8	360 – 500
PSS25F	25	1.0	165	6.5	360 – 500
PSS55A	55	2.3	250	10.4	90 – 140
PSS55B	55	2.3	250	10.4	180 – 260
PSS55C	55	2.3	250	10.4	360 – 500
PSS160E	—	—	—	—	90 – 260
PSS160C	—	—	—	—	360 – 500
PSS300E	—	—	—	—	90 – 260
PSS300C	—	—	—	—	360 – 500
PSS600C	—	—	—	—	360 – 500

Before sizing the power supply, the continuous and inrush watts or amperes of each load must be identified. This is not much different than adding up the volt-ampere requirements when sizing a control power transformer. In addition, the sequence of operation of the devices needs to be determined to ensure that the worst case conditions are used in sizing the power supply.

For example, a system being designed requires: *two* ***IT.*** A-Frame IEC contactors, *one* C-Frame IEC starter, *three* indicating lamps, and *one* auxiliary relay. The power requirements for each device are given in the following table.

Table 2. Power Requirements

Device	Watts Per Device	
	Continuous (Sealed)	Inrush (Peak)
A-Frame IEC Contactor	1.3	20.0
C-Frame IEC Starter	3.6	90.0
Indicating Lamp	1.2	1.2
Auxiliary Relay	1.2	7.2

In the first example, *all of the devices will be operated at the same time*. The available line voltage is 230V AC. Two calculations are required — the first, to determine the continuous wattage requirement and the second, for the peak wattage.

- Continuous watts = sum of continuous (sealed) watts of each device.

  Continuous watts = (2 x 1.3) + (1 x 3.6) + (3 x 1.2) + (1 x 1.2).

  Continuous watts = 11.

- Peak watts = sum of inrush (peak) watts of each device.

  Peak watts = (2 x 20) + (1 x 90) + (3 x 1.2) + (1 x 7.2).

  Peak watts = 140.8.

In this case, a PSS25E power supply would be chosen, since it has a continuous rating of 25 watts and a peak rating of 165 watts which are appropriate for the calculated 24V DC power requirements.

As a second example, the same devices will be used but the operation will be different. In this case the designer wants to be able to *close any device while all of the others are operating*. The worst case peak power requirements will occur when all of the other devices are operating and the C-Frame starter is picked up. Again, two calculations are required, one for the continuous (sealed) and one for the inrush (peak) power requirements.

- Continuous watts = sum of continuous (sealed) watts of each device.
- Continuous watts = (2 x 1.3) + (1 x 3.6) + (3 x 1.2) + (1 x 1.2).
- Continuous watts = 11.
- Peak watts = sum of continuous (sealed) watts of each operating device plus the inrush (peak) watts of the worst case device being picked up.
- Peak watts = (2 x 1.3) + (3 x 1.2) + (1 x 1.2) + (1 x 90).
- Peak watts = 97.4.

In this case the PSS25E power supply would be chosen to meet the calculated requirements.

It must also be noted that the power requirements above are based on the devices being operated in a 20ºC (68°F) environment. If the temperature differs from 20ºC (68°F), the wattage requirements will change for many devices. The device instruction literature will supply information as to which if any factors are to be used for other operating temperatures. As an example, for the ***IT.*** IEC contactor and starter products, the following table is published in the User Manual, pub49400, which provides an equation for determining power requirements at temperatures different than 20ºC (68°F).

Table 3. 24V DC Power Supply Requirements at 20°C (68°F)

Contactor/Starter Size			Sealed In		Inrush		
Catalog Number ①	Frame	mm	Wattage	Amperes	Wattage	Amperes	Duration (msecs)
E_11A_ _X3N	A	27	1.3	0.054	20	0.83	30
E_11B_ _X3N	B	45	3.7	0.15	80	3.3	50
E_01B_ _ _3A	B	45	3.2	0.13	80	3.3	50
E_11C_ _X3N	C	54	4.2	0.18	90	3.8	50
E_01C_ _ _3A	C	54	3.6	0.15	90	3.8	50
E_ _1D_ _ _3_	D	76	5.0	0.21	130	5.4	65
E_ _1E_ _ _3_	E	105	5.6	0.23	140	5.8	85
E_ _1F_ _ _3_	F	140	②	②	②	②	②

① Indicates missing digit of the catalog number may have multiple values.
② Consult factory.

Note: At other temperatures expressed in °C, for either inrush or sealed, use the 20°C value from the table in the following:
Watts = W_{20} [1.1-0.005(T)] and Amps = A_{20} [1.1-0.005(T)]
For example, inrush requirements for a D-Frame starter at -25°C would be:
Watts = 130 [1.1-0.005(-25)] = 160
Amps = 5.4 [1.1-0.005(-25)] = 6.6

In addition, operation at ambient temperatures greater than the 24V DC power supply temperature rating will require that the power supply be derated. See the applicable power supply installation manual.

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