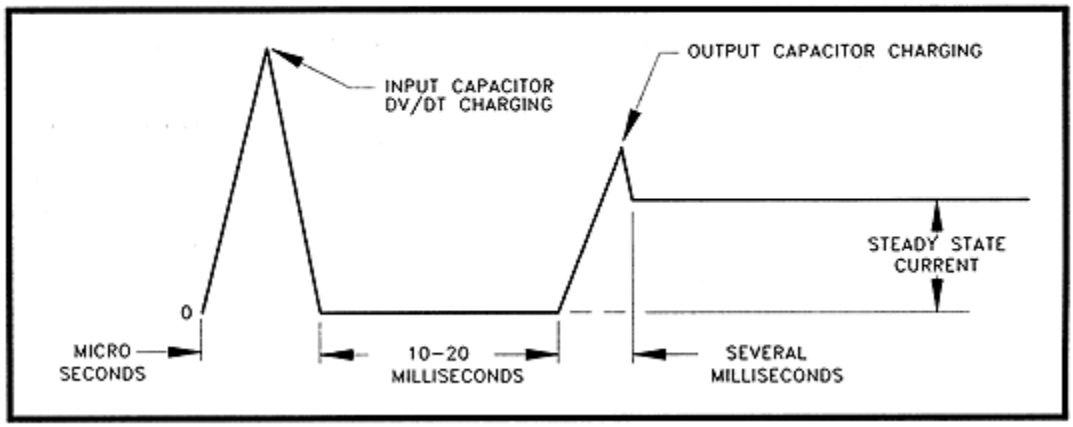
DC Power Input Considerations

Input Rise Time and Inrush Current 2000, 3000, 4000, and 6000 Series

There are no practical constraints on how fast or how slow the input voltage can be safely applied to the full featured DC-DC Converters. The typical input current as a function of time is shown in Figure 2.

Figure 2
Typical Input Current Vs. Time



There are two peaks in the current waveform. The first peak is due to input EMI filter capacitor charging. The capacitor charging peak current is dependent on the rate of rise of input voltage. Although the inductance and resistance of the input EMI filter limit the initial inrush current to some extent, the small cores in the filter tend to saturate during initial turn-on.

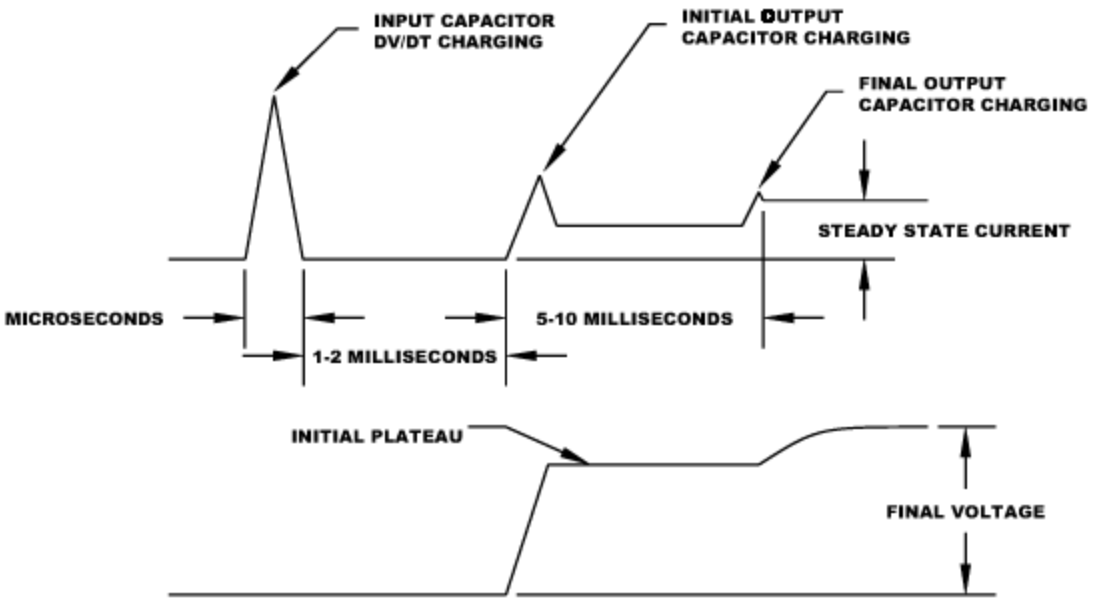
The second peak is due to the converter coming on and supplying the load as well as the internal and external load capacitance.

It can be seen that the initial inrush current due to capacitor charging will be highly dependent on the rate of rise of input voltage. Therefore, to limit inrush current, limit the rise time of the input voltage.

Input Rise Time and Inrush Current 5000, 7000, 8000, and 9000 Series

The 5000, 7000, 8000 and 9000 series Proton Rad Hard DC-DC use a magnetic feedback circuit instead of an optocoupler for feeding back the output side voltage.

Because the response time of the magnetic feedback circuit is different than that of an optocoupler, the output voltage turn on waveform and input current waveform is also different, as shown in the figure below:



INPUT RISE TIME AND INRUSH CURRENT: 5000, 7000, 8000 AND 9000 SERIES

There are three peaks in the current waveform. Also, the output voltage is established at a magnitude less than the final set point voltage, then rises to the set point value without any overshoot.

The first input current peak is due to input EMI filter capacitor charging. The capacitor charging peak current is proportional to the rate of rise of input current and proportional to the magnitude of the EMI filter capacitance (as listed in the table). The limiting effect of the EMI filter inductors is negligible because of the inductor's small sizes. The input EMI filter charging current is usually the largest inrush current and can be controlled by externally limiting the initial rate of rise on input voltage.

The second input current peak is due to the converter initially coming on and supplying sufficient voltage to operate the magnetic feedback circuit. This initial voltage plateau is always less than the desired regulated output voltage. The input current during this portion of the waveform is due to the charging of the internal and external output capacitances as well as the resistive load current at the plateau voltage.

After a delay of 5 to 10 milliseconds, the output voltage exponentially reaches the final regulation set point without any output voltage overshoot.

The third current peak, if any is present, is due to the charging of the internal and external output capacitances to the final set point voltage as well as the resistive load current at the final set point voltage.

The approximate input capacitance of each converter is given in Table 1.

Table 1

Conversion Chart for Model Number and Capacitance Value

Model	Input Capacitance	Model	Input Capacitance
2680	13.5µ	5031	24.0µ
2690	4.5µ	5107	9.0µ
3000	1.98µ	5193	18.0µ
3001	13.5µ	5680	13.5µ
3011	9.0µ	5690	4.5µ
3020	0.66µ	6031	24.0µ
3031	24.0µ	6107	9.0µ
3041	2.64µ	6193	18.0µ
3051	18.4µ	6680	13.5µ
3060	10.8µ	6690	4.5µ
3061	6.6µ	7031	24.0µ
3062	6.0µ	7107	9.0µ
3070	3.6µ	7193	18.0µ
3080	3.0µ	7680	13.5µ
3107	9.0µ	7690	4.5µ
3108	7.2µ	8031	19.2µ
3109	1.32µ	8107	7.2µ
3113	9.0µ	8193	10.8µ
3114	18.0µ	8680	10.8µ
3138	18.0µ	8690	3.6µ
3193	18.0µ	9031	19.2µ
3325	1.0µ	9107	7.2µ
3326	14.4µ	9193	10.8µ
3327	1.98µ	9680	10.8µ
3378	13.5µ	9690	3.6µ