Selection Criteria for DC Power Supplies

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Selection Criteria for DC Power Supplies Outline

- Power supply types
- Key specifications
- Constant voltage / constant current operation
- Remote sensing
- Inductive loads
- Pulsed loads
- Paralleling & series operation
- Analog programming
- Thermal management
Power Supply Types

- Linear
- Switch mode
  - Pulse width modulation (PWM)
  - Zero voltage switching ZVT (a.k.a. ‘soft switching’)

Linear Power Supply (basic design)

Advantages:
- Low noise
- Fast transient response
- Simple design

Disadvantages:
- Poor efficiency
- Large
- Heavy
Switching Power Supply (basic design)

Advantages:
- Higher efficiency
- Smaller size/weight

Disadvantages:
- Higher p-p noise
- Slower transient response (compared to linear)
Noise Profile on Linear vs. Switching

Typical linear power supply

Typical switching power supply
Noise and Ripple Specifications: No Standard

- Different manufacturers use different methods
- ‘Paper’ specifications not always comparable
- Other may measure in 20 Hz – 200 kHz
- Some do not specify bandwidth at all...
Key Power Supply Specifications

- Load regulation
- Rise time; fall time
- Transient response
- Noise and ripple
- Efficiency
- Input power factor
Load Regulation

Percent change of $V_{out}$ as a function of load change

PSU \quad \text{Varying Load}

Output voltage

\begin{align*}
\text{100\%} & \\
\text{0\%} & \\
\end{align*}

Load current
Output Rise Time

Sorensen SG Series is 100 ms for 0 to maximum DC output voltage
Fast off time is especially critical in production testing and other applications where speed is important.
Transient Response Time

\[ T_r = \text{Transient response time} \]

Typically 1-10 ms
AC Mains Input Power Factor

Bad power factor causes:
- very high peak currents
  • requires thicker wiring and larger breakers
- large harmonic distortion
Voltage & Current Mode Operation

• General-purpose programmable power supplies typically have the capability to operate as either a voltage source (constant-voltage mode operation) or a current source (constant-current mode operation)

• PSU switches between CV and CC automatically based on the load

• If $I_{\text{Load}} < I_{\text{SET}} = \text{constant voltage (CV) mode}$
• If $I_{\text{Load}} > I_{\text{SET}} = \text{constant current (CC) mode}$
Local Sense Considerations

6 mm² wire is typically 3 mΩ/m; 10 m = 30 mΩ
If I = 20 A: \( V_r = 20 \times 30 \text{ mΩ} = 600 \text{ mV} \) drop per line; total 1.2 V!
Remote Sense Considerations

- Advantages:
  - Better regulation at the load
  - Better voltage accuracy
Remote Sense & Load Switching

Power Supply

\[ +S \]
\[ + \]
\[ - \]
\[ -S \]
Connecting the sense lines after the switch means the sense line will carry the full load current should those switches become open.
Remote Sense & Load Switching

- Correct method:
  - Sense connections on power supply side of switch
Inductive Load Considerations

- Adding a reverse-biased diode across the load will absorb reverse currents that occur when power is removed from the inductive load.
- Diode should be rated 1.5 times the output power rating of the power supply.
Inductive Load Considerations cont’d

- Adding a diode in series with the load will block back EMF from damaging the power supply.
- Blocking diode should be rated seven times the output power rating of the power supply.
Pulsed Loads

Power supply may need to be sized for I peak!

- Typical loads:
  - Inverters (DC → AC)
  - DC to DC converters
  - Audio amplifiers
Parallel Operation

Two methods:

• Manual
  – Both supplies in voltage mode

• Current share
  – Master/slave
  – All in current mode; analog signal split to each supply
  – Dedicated analog paralleling cable
  – Multiple power supplies in parallel
  – Is de-facto extension of the internal control loop
  – Very fast
Parallel Operation

Current sharing

Power Supply PS1
- Monitor Out
  +
  -
  -S

Power Supply PS2
- I Prog In
  +
  +
  -
  -S

Programming & Control

LOAD
Analog Programming

- Allows you to program the power supply’s voltage and current output by providing a 0-10 V external programming voltage
- Allows you to also read back a power supply’s status
- Fastest programming possible
- Limited to approx. 4 Hz on most supplies (i.e. can not be used as a power amplifier)
Thermal Management Considerations

• If incorporating power supply’s into a cabinet, make sure to:
  – Provide exhaust capabilities to the cabinet
  – Keep the internal operating temperature of the cabinet at or below the operating temperature rating of the power supplies

• Switching power supplies are approx. 90% efficient in most cases; linears are 60%

• That is 10% to 40% of power that is dissipated as heat!
Product Portfolio – Rack Mount

- 1.2 kW XFR
- 2.8 kW XFR
- 3 & 4 kW DLM
- 3.3-10 kW P63
- 5-30 kW SGI
- 5-30 kW SGA
- 5-20 kW DHP

Clear Vision • Sound Strategies • Solid Performance
Product Portfolio – Bench Top

- 30 W to 420 W
  - XPL
  - XPH
  - XPF
  - XDL
- 60 W
  - XT
- 300 W
  - HPD
- 500 W
  - XPD
- 600 W
  - DLM
- 1 kW
  - XHR
Product Portfolio – Multiple Output

ReFlex Power RFP

2.4 kW XMP
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