



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

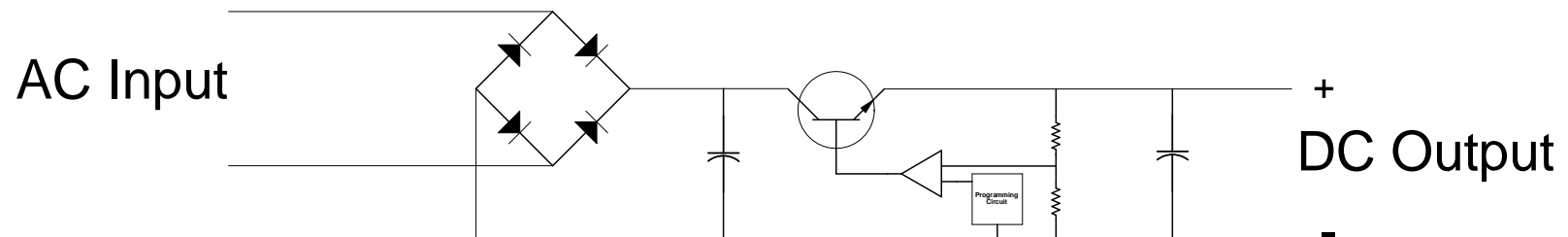


Power Supply Types

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



Linear Power Supply (basic design)



Advantages:

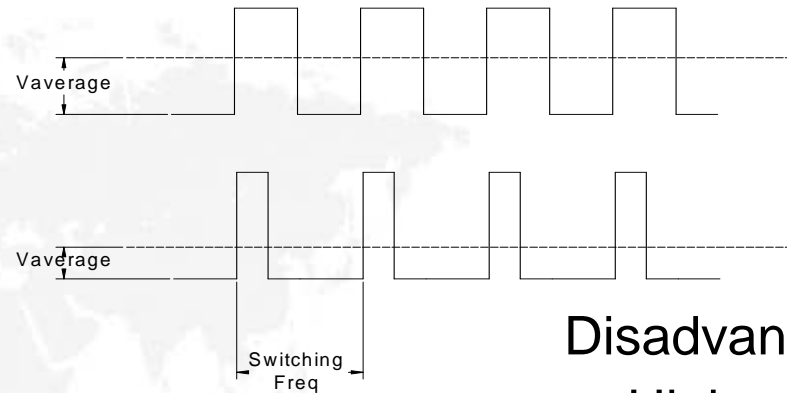
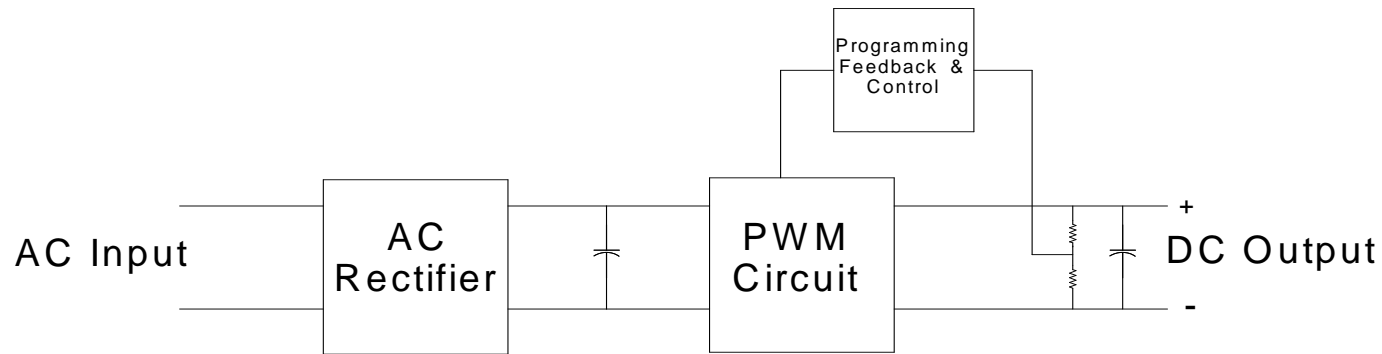
- Low noise
- Fast transient response
- Simple design

Disadvantages:

- Poor efficiency
- Large
- Heavy



Switching Power Supply (basic design)



Advantages:

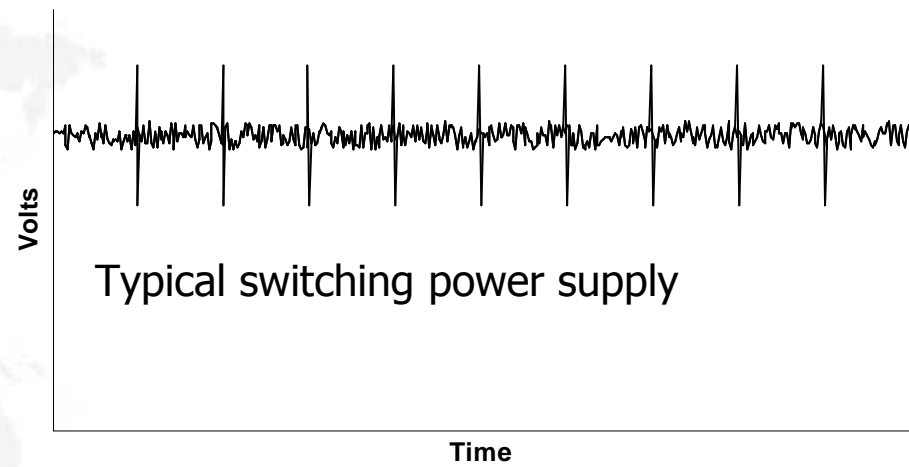
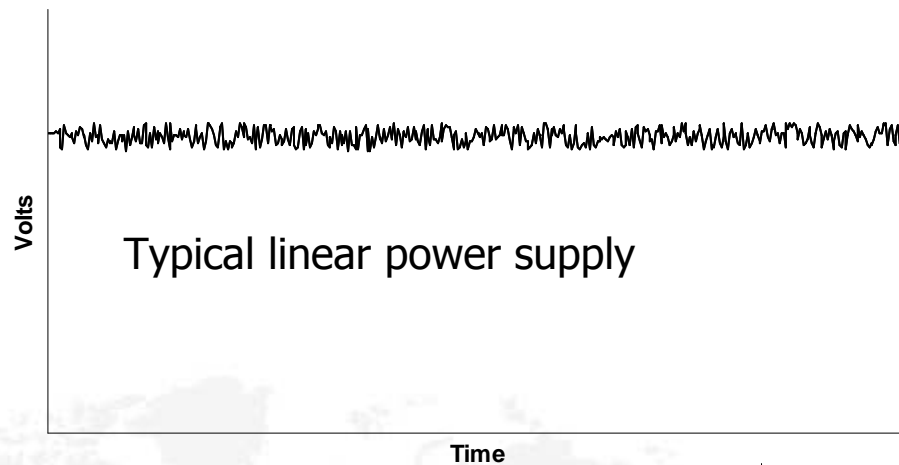
- Higher efficiency
- Smaller size/weight

Disadvantages:

- Higher p-p noise
- Slower transient response (compared to linear)



Noise Profile on Linear vs. Switching





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...



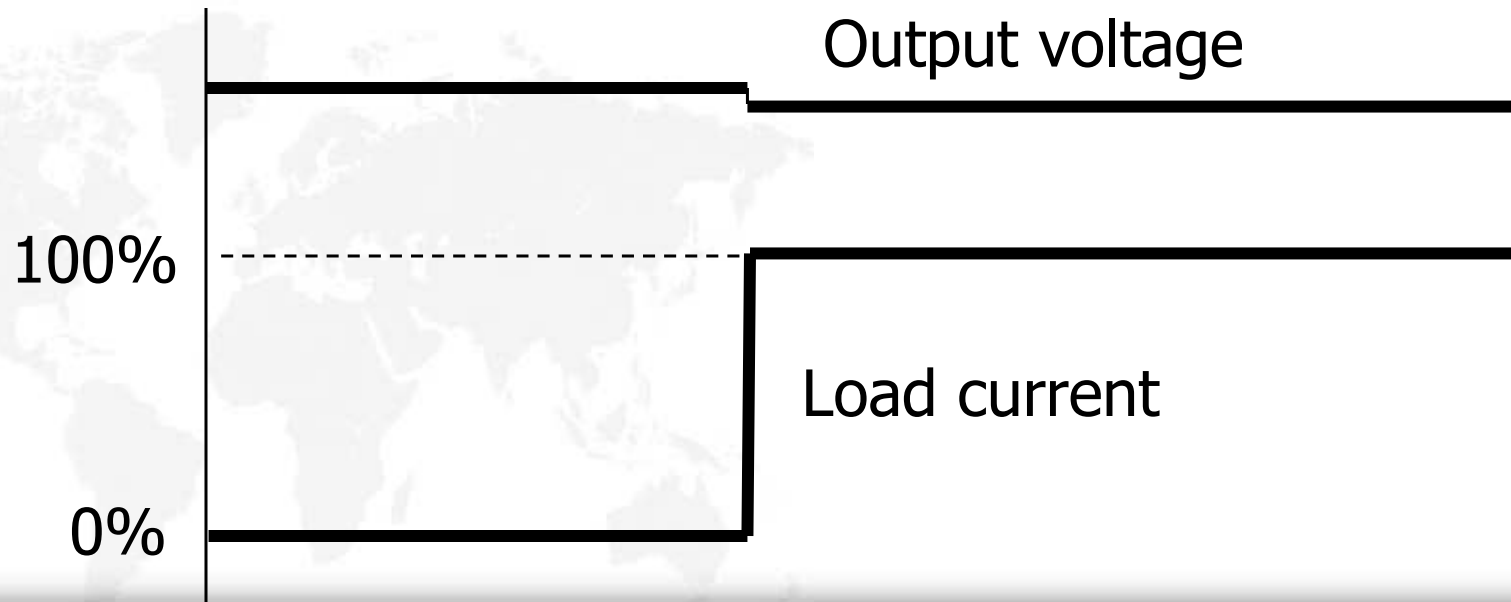
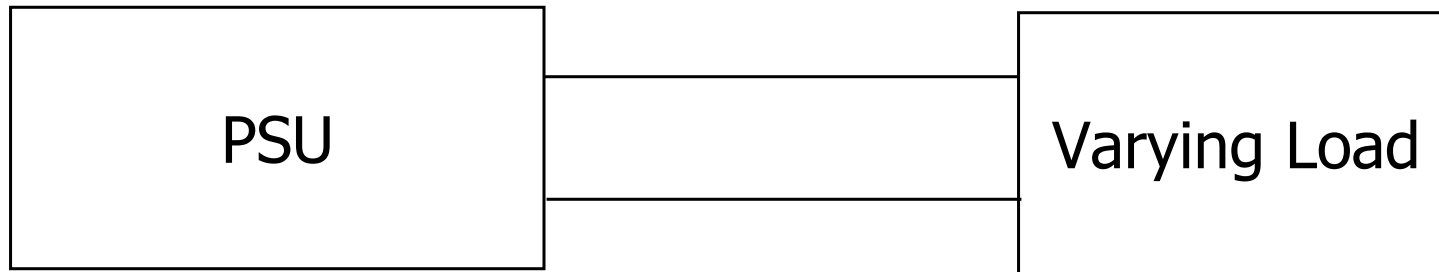
Key Power Supply Specifications

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



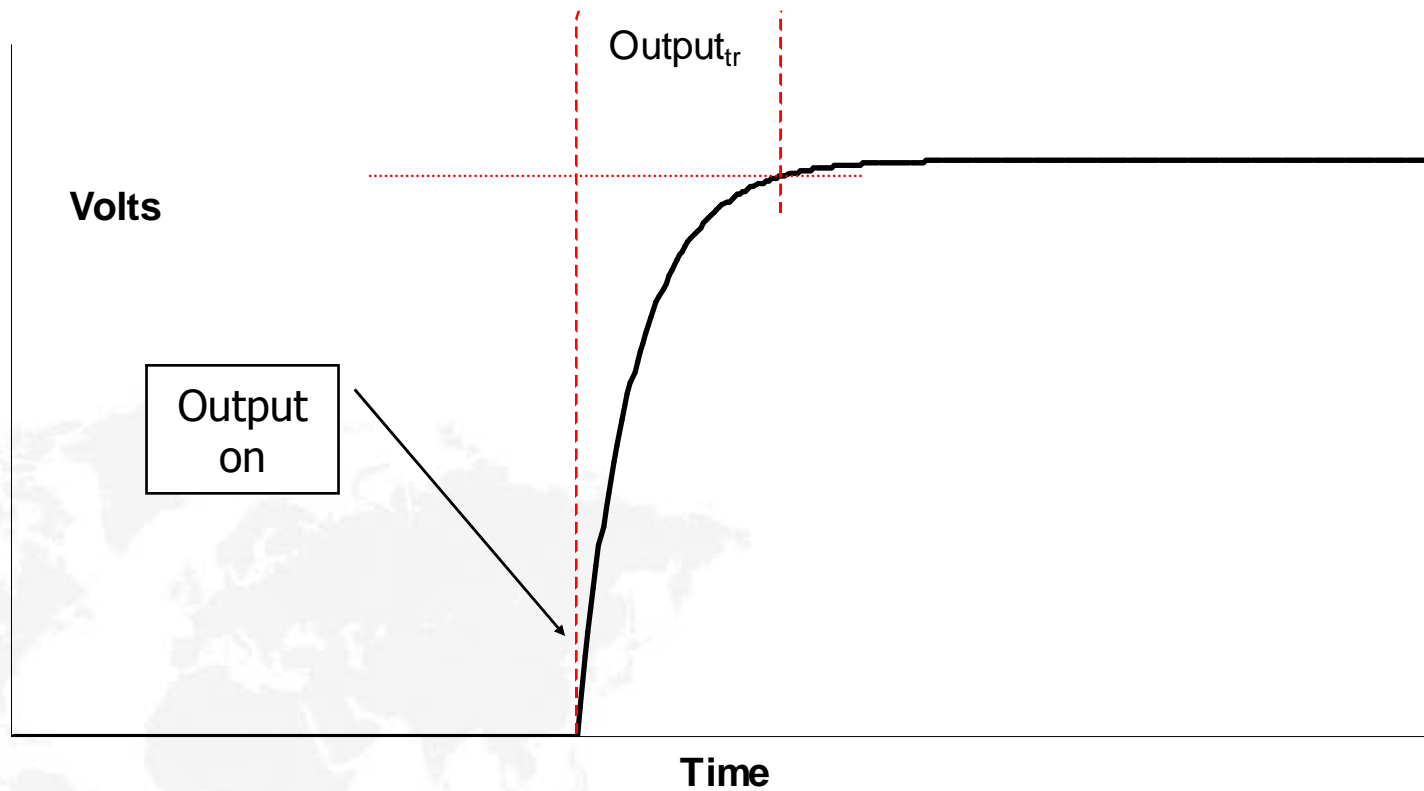
Load Regulation

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





Output Rise Time

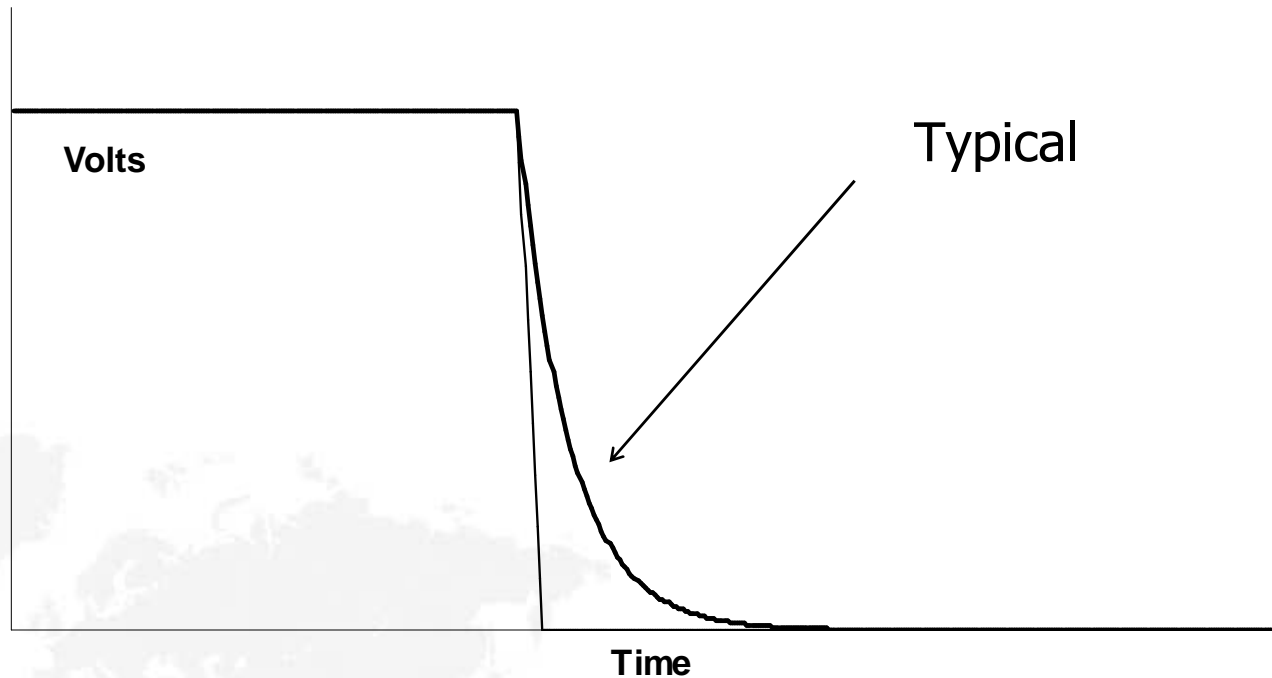


Output_{tr} = rise time

Sorensen SG Series is 100 ms for 0 to maximum DC output voltage



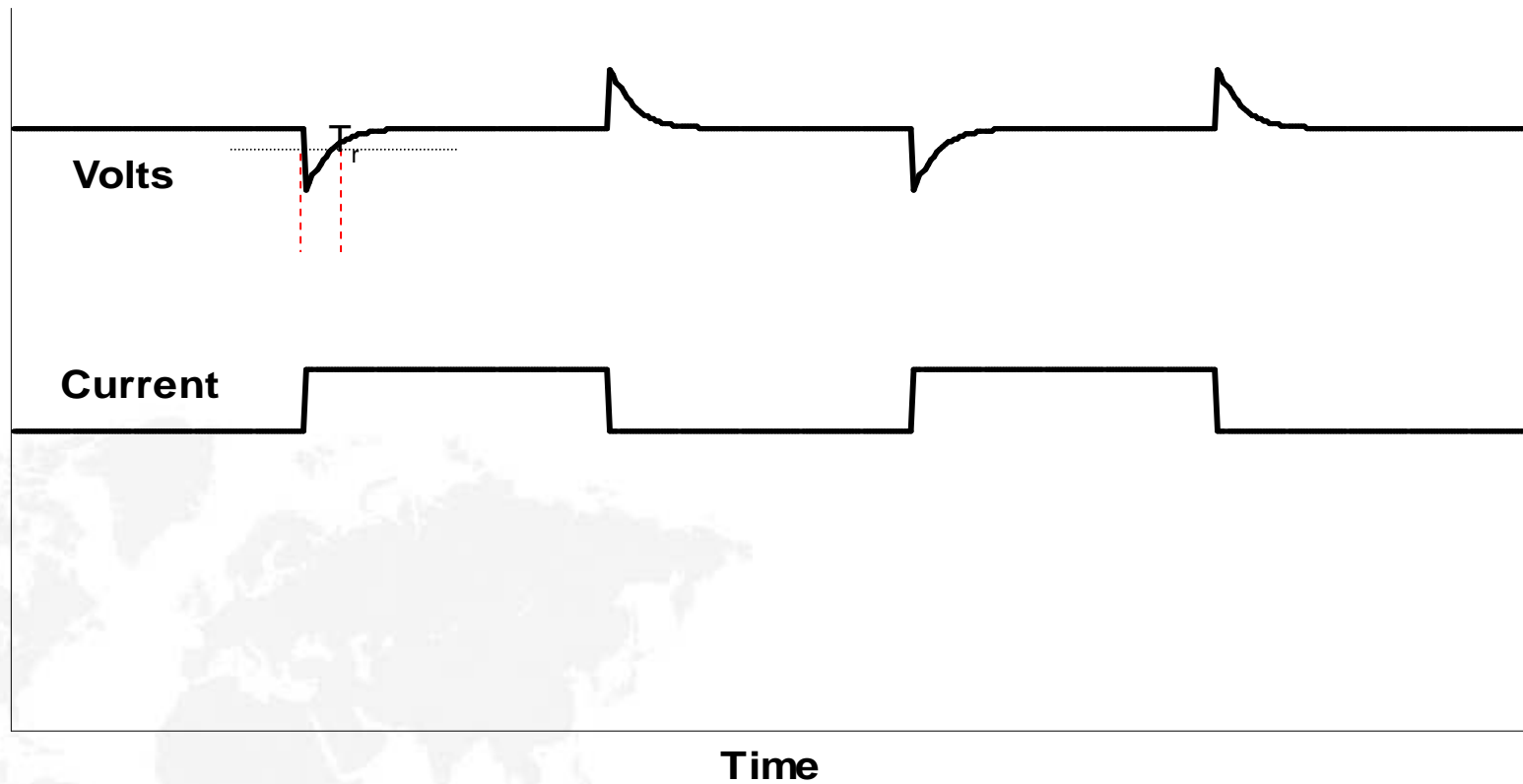
Output Fall Time



Fast off time is especially critical in production testing and other applications where speed is important



Transient Response Time



T_r = Transient response time

Typically 1-10 ms



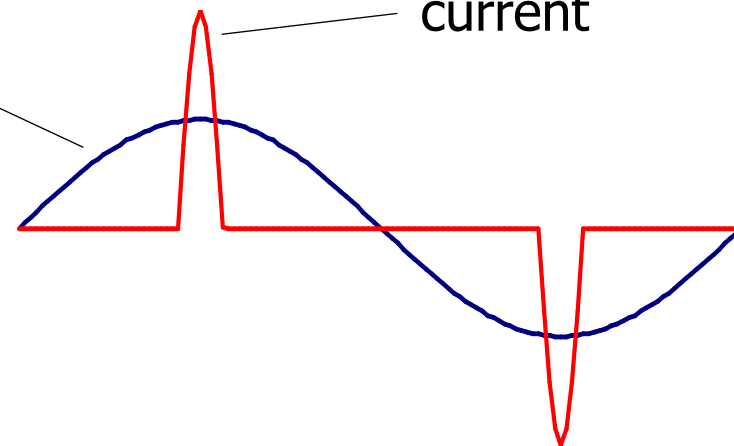
AC Mains Input Power Factor

Bad power factor causes:

- very high peak currents
 - requires thicker wiring and larger breakers
- large harmonic distortion

voltage

current



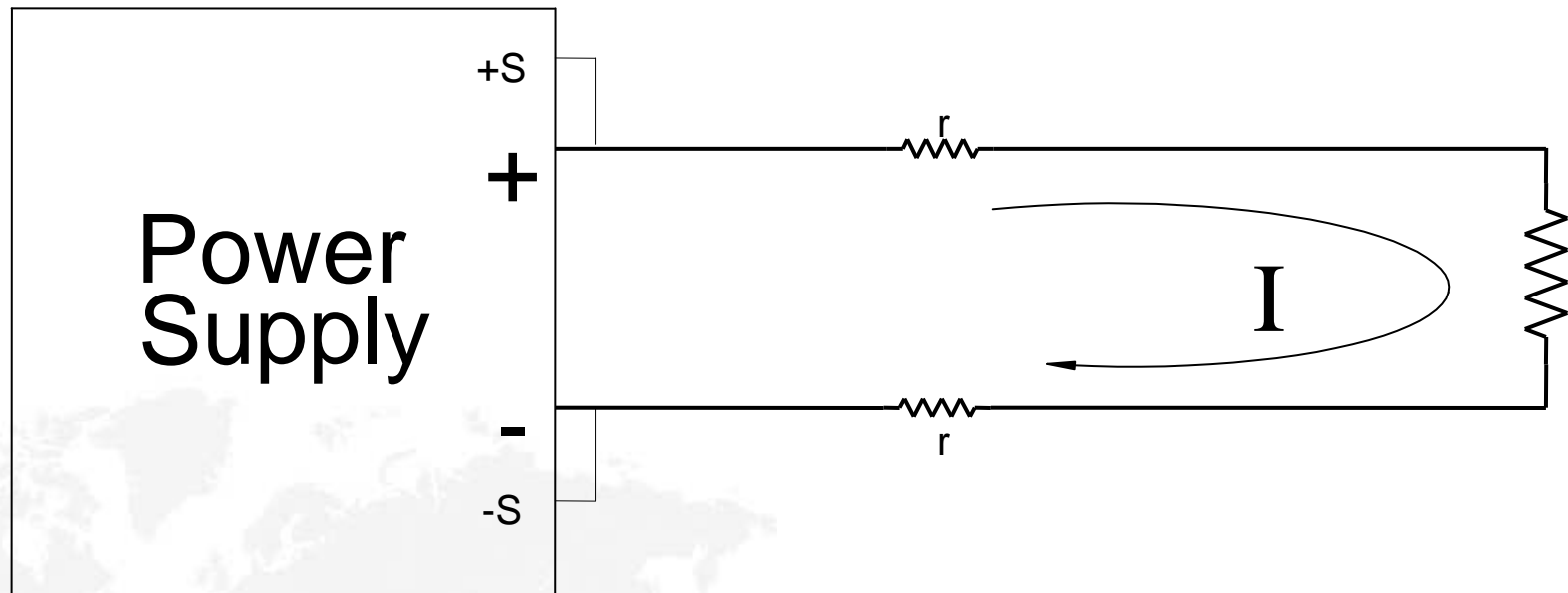


Voltage & Current Mode Operation

- 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 $I_{Load} < I_{SET}$ = constant voltage (CV) mode
- If $I_{Load} > I_{SET}$ = constant current (CC) mode



Local Sense Considerations

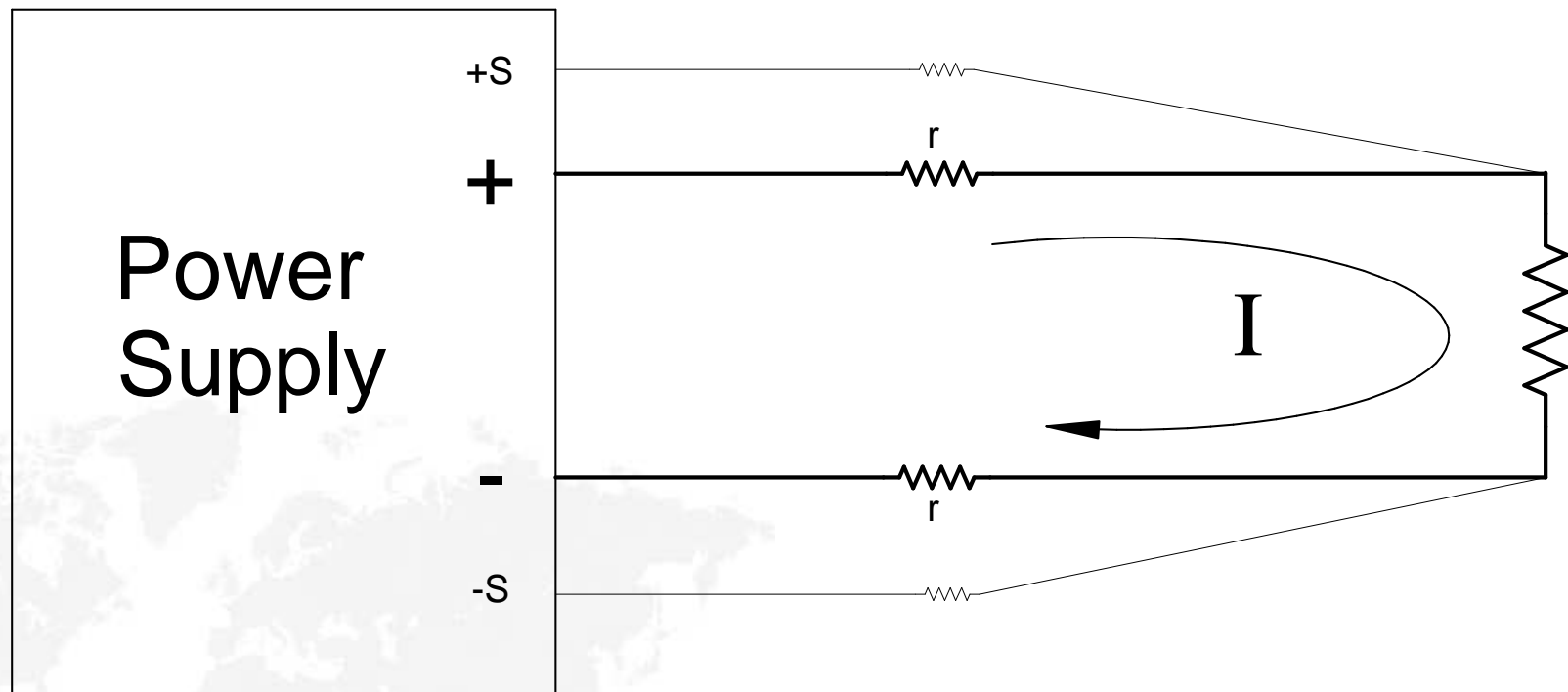


6 mm² wire is typically 3 mΩ/m; 10 m = 30 mΩ

If I = 20 A: $V_r = 20 \text{ A} \times 30 \text{ m}\Omega = 600 \text{ mV}$ drop per line; total 1.2 V!



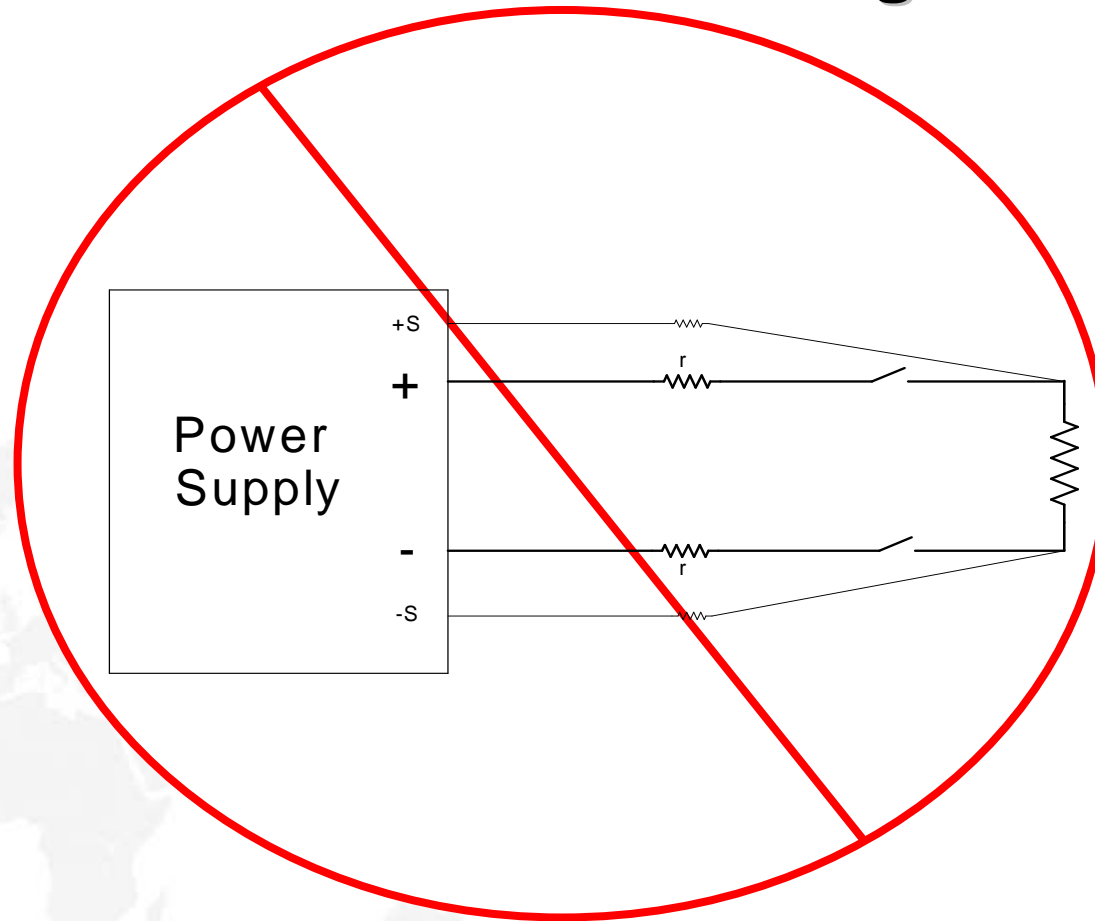
Remote Sense Considerations

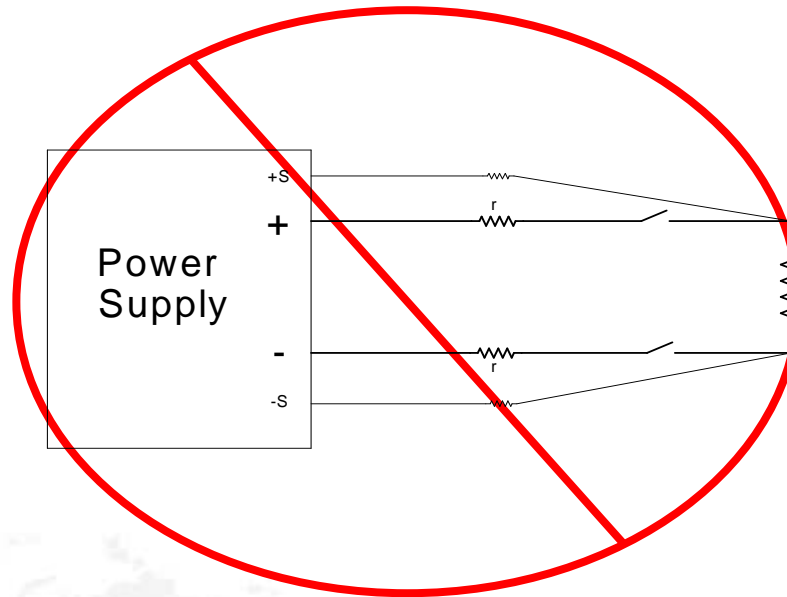


- Advantages:
 - Better regulation at the load
 - Better voltage accuracy



Remote Sense & Load Switching

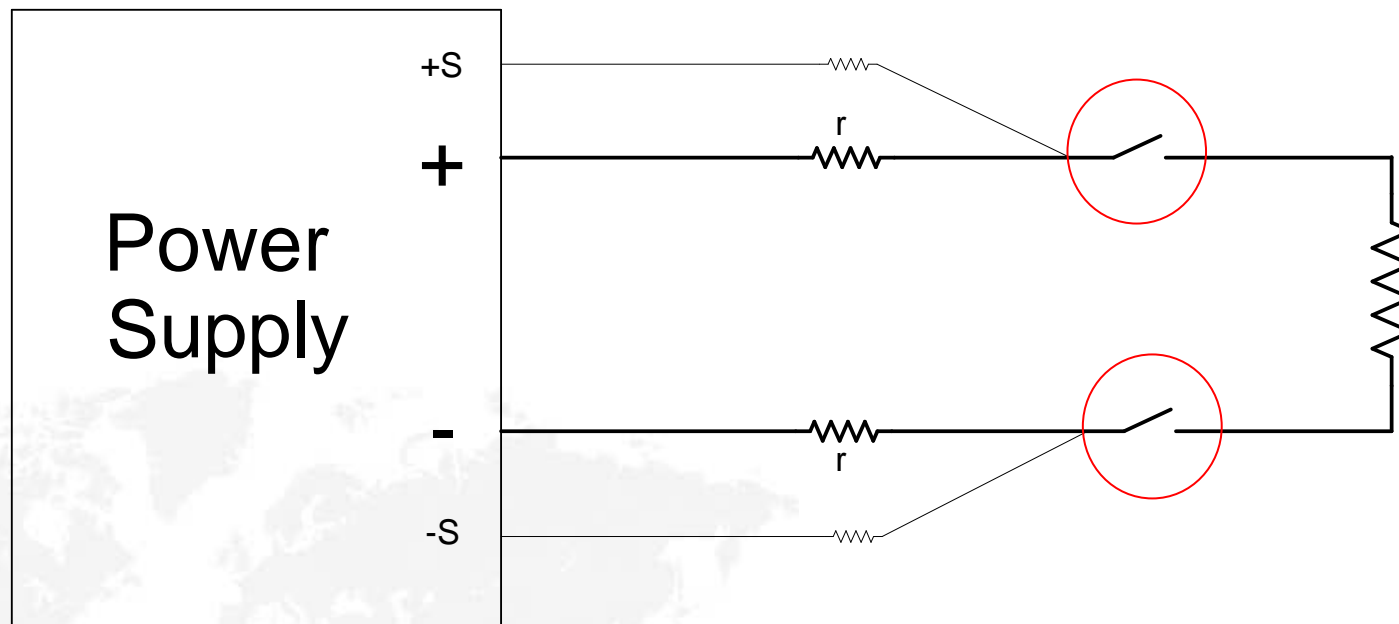




Connecting the sense lines after the switch means the sense line will carry the full load current should those switches become open



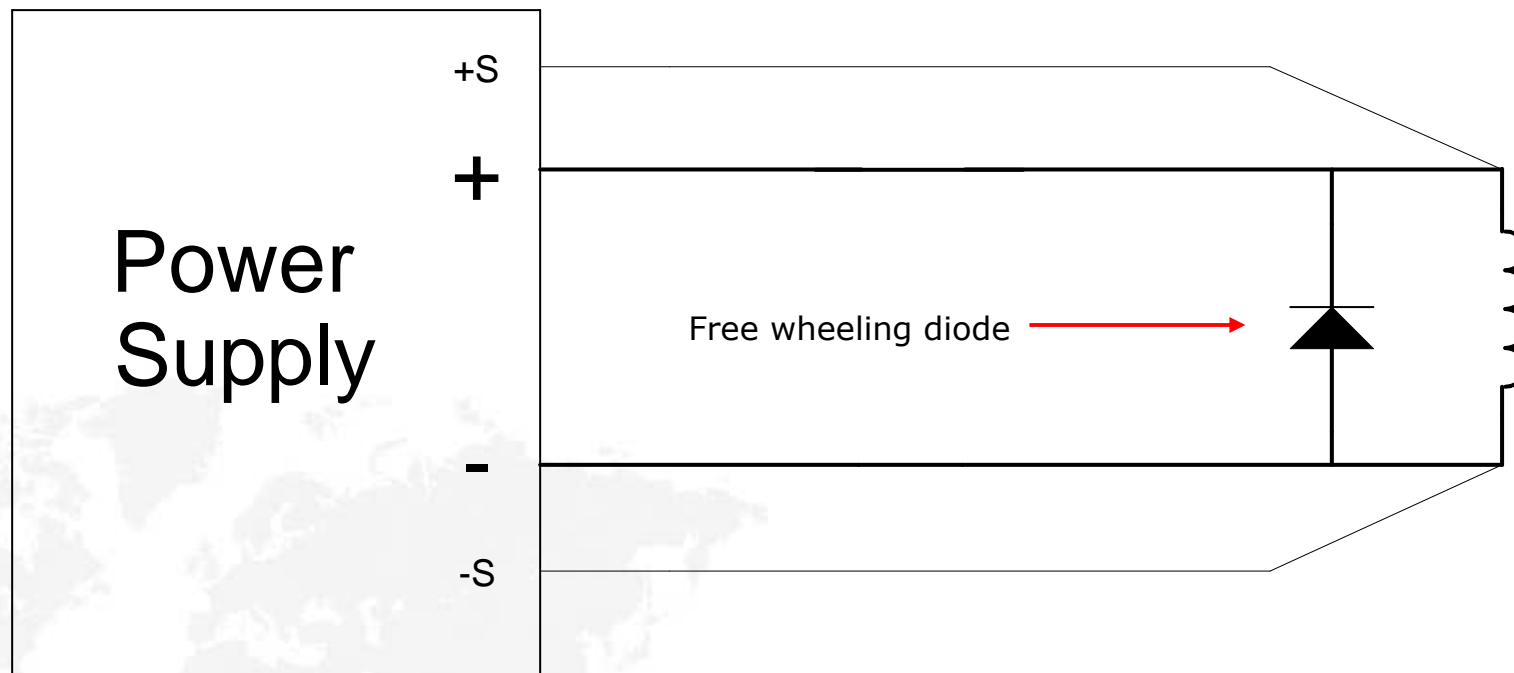
Remote Sense & Load Switching



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



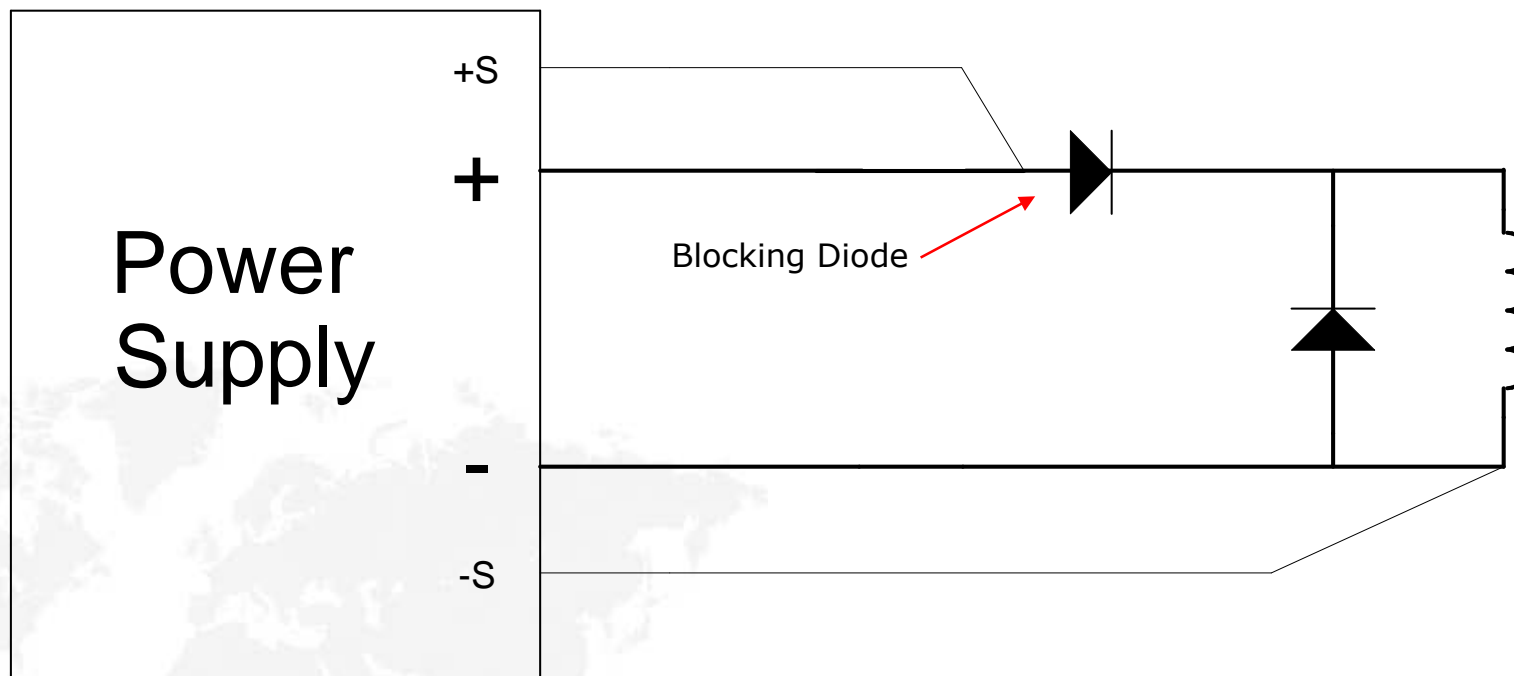
Inductive Load Considerations



- 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



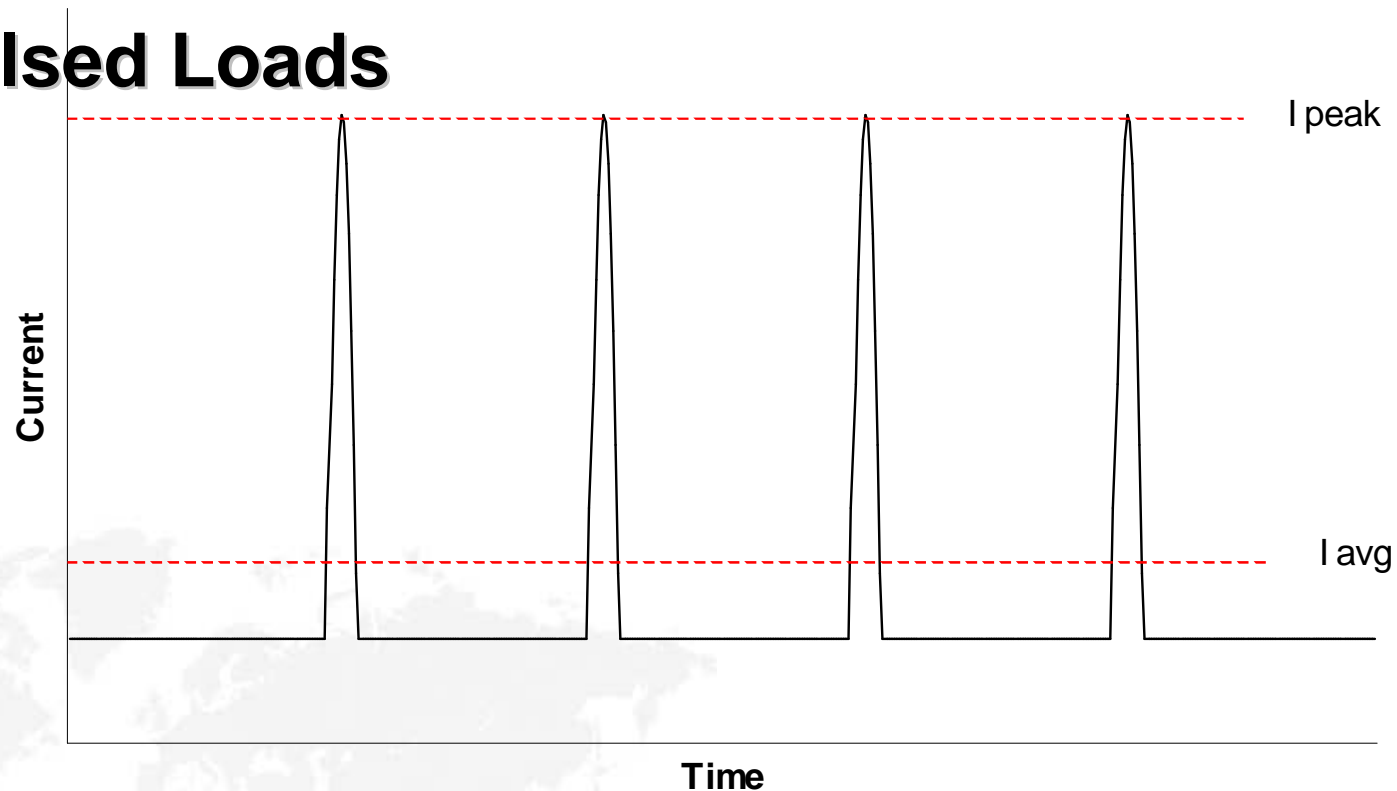
Inductive Load Considerations cont'd



- 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 \rightarrow AC)
 - DC to DC converters
 - Audio amplifiers



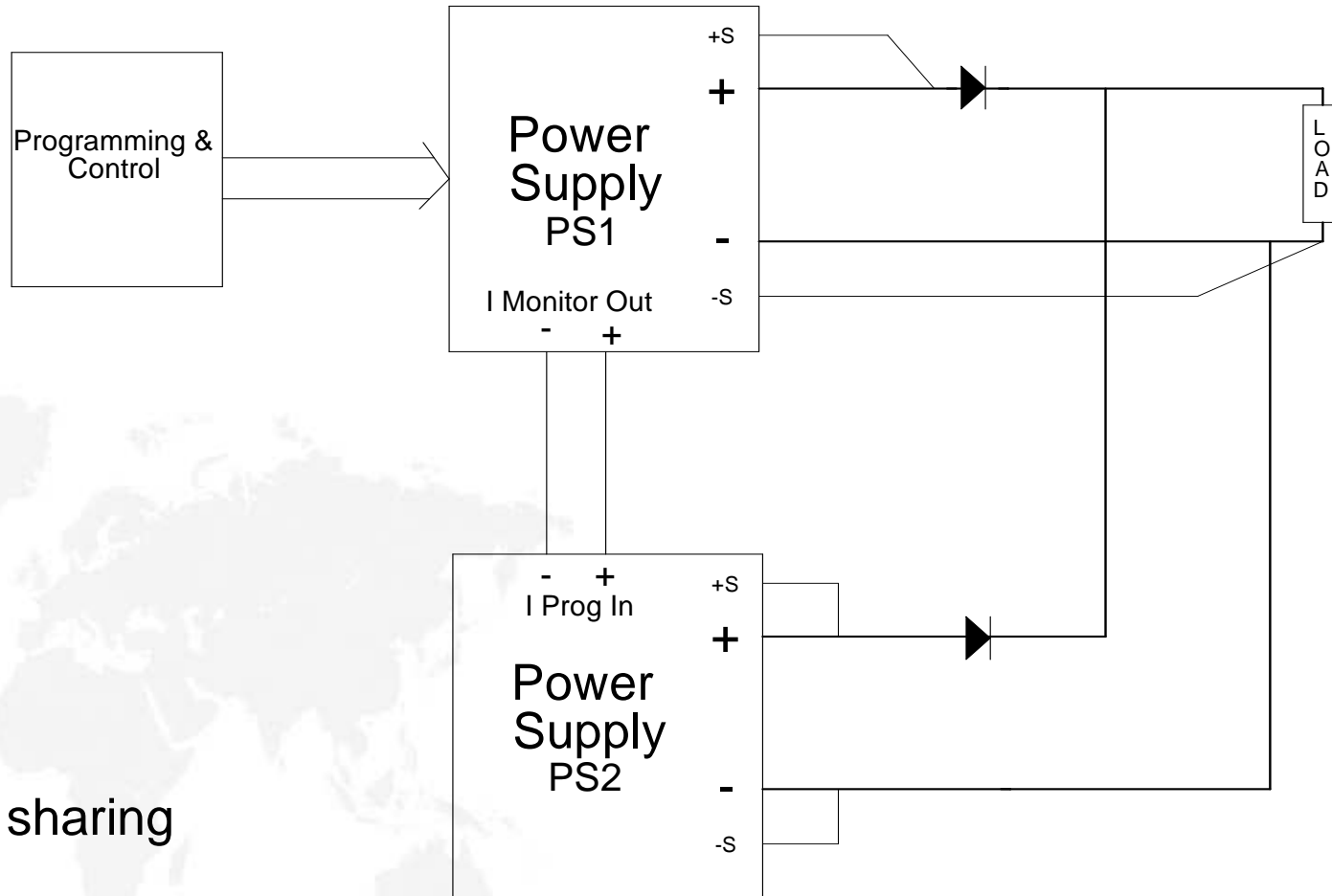
Parallel Operation

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



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)

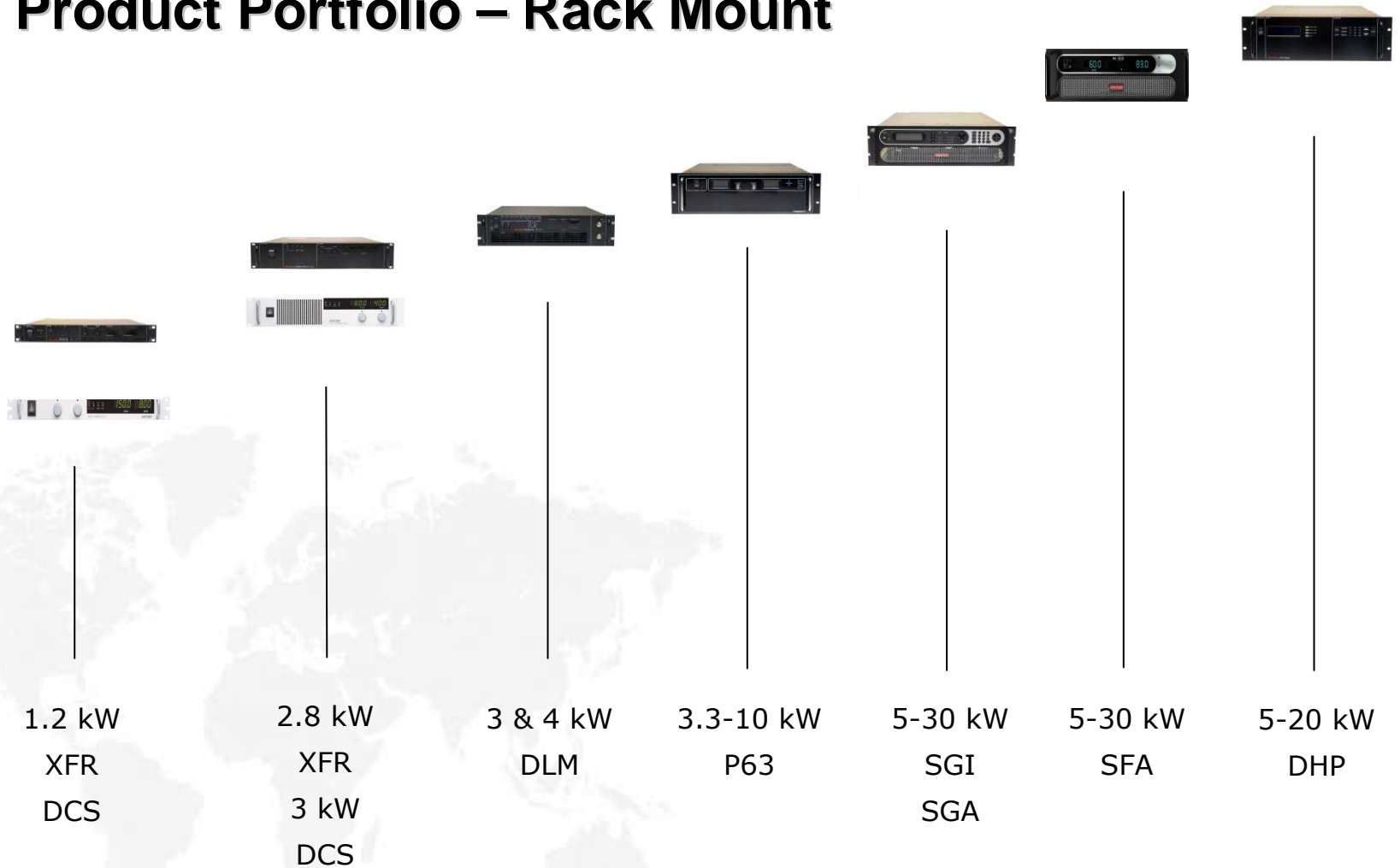


Thermal Management Considerations

- 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





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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