

Smart choice for power

xantrex

DC Power Supply Basics



Xantrex Technology Inc.

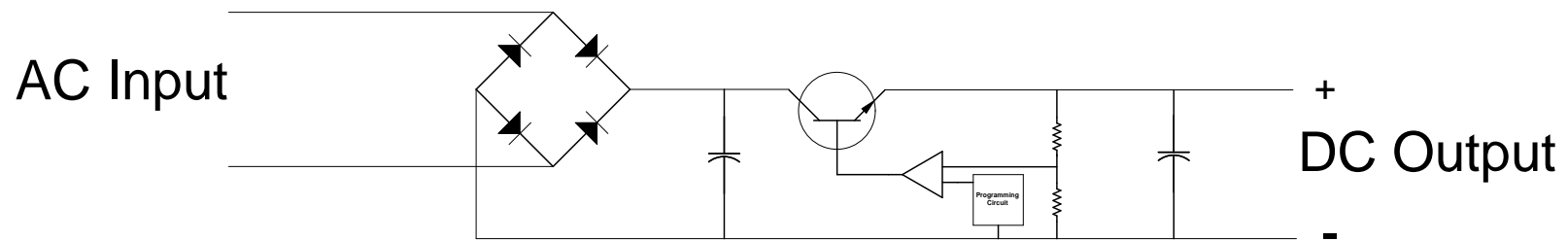
DC Basics Outline

- Basic power supply types
- Key specifications
- Constant voltage / constant current operation
- Remote sensing
- Inductive loads
- Pulsed loads
- Paralleling & series operation
- Analog programming
- Thermal management
- Regulatory
- ATE considerations

Basic Power Supply Types

- Linear
- Switch mode
 - PWM
 - ZVT (a.k.a. 'soft switching')

Linear Power Supply (basic design)



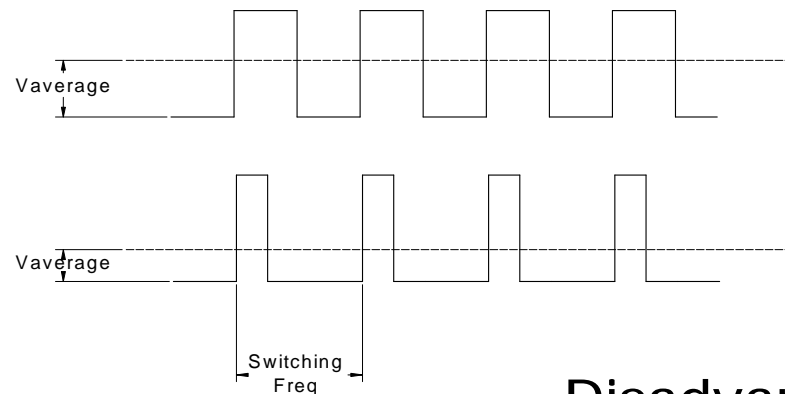
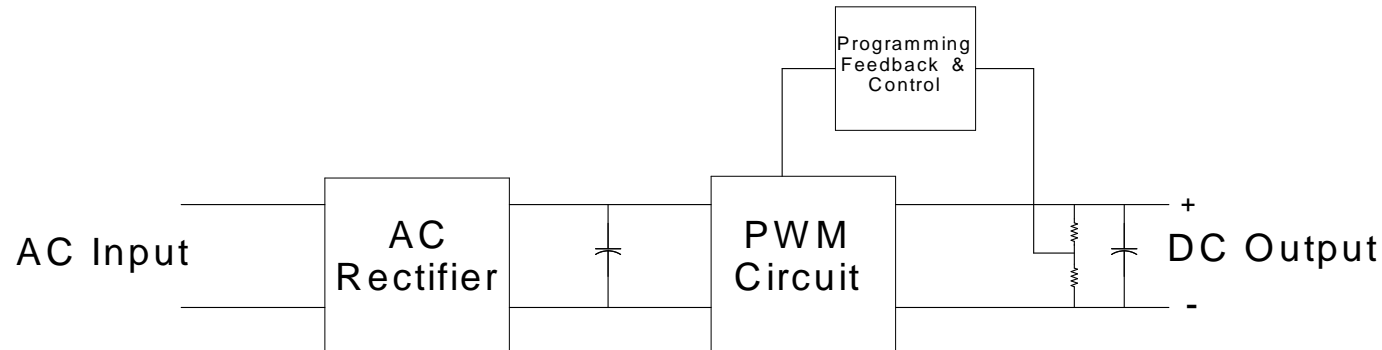
Advantages:

- Low noise
- Fast transient response
- Simple design

Disadvantages:

- Poor efficiency
- Large
- Heavy

Switching Power Supply (basic design)



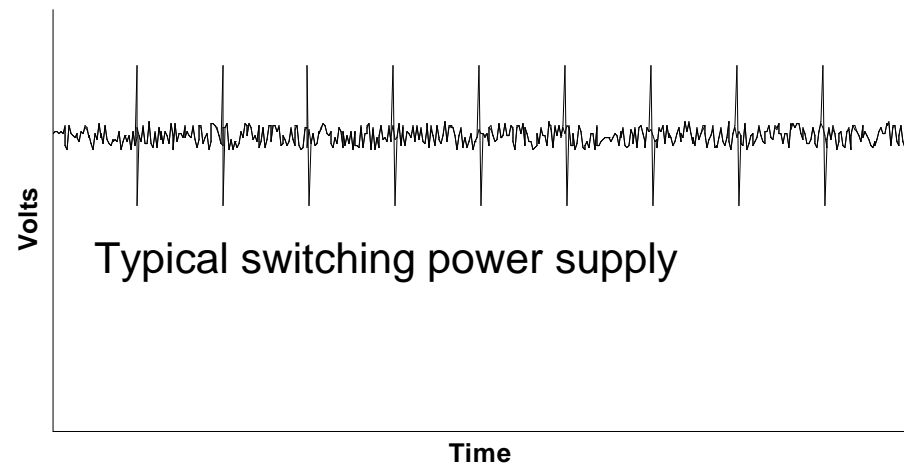
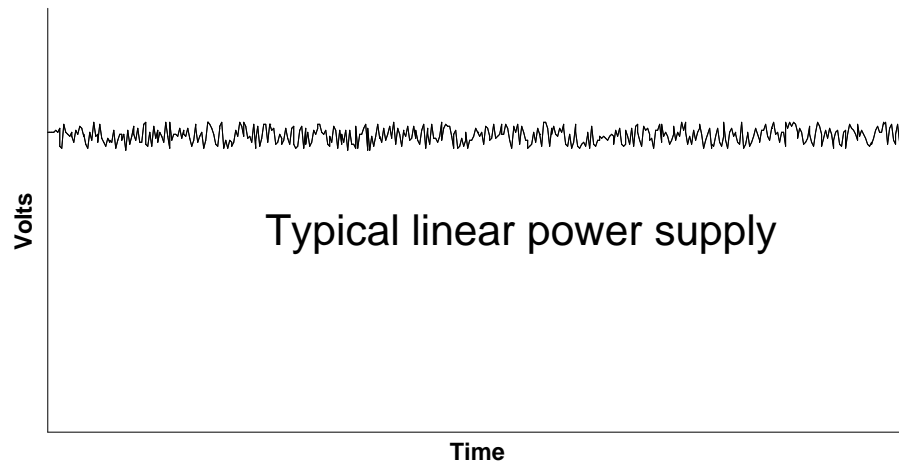
Advantages:

- 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

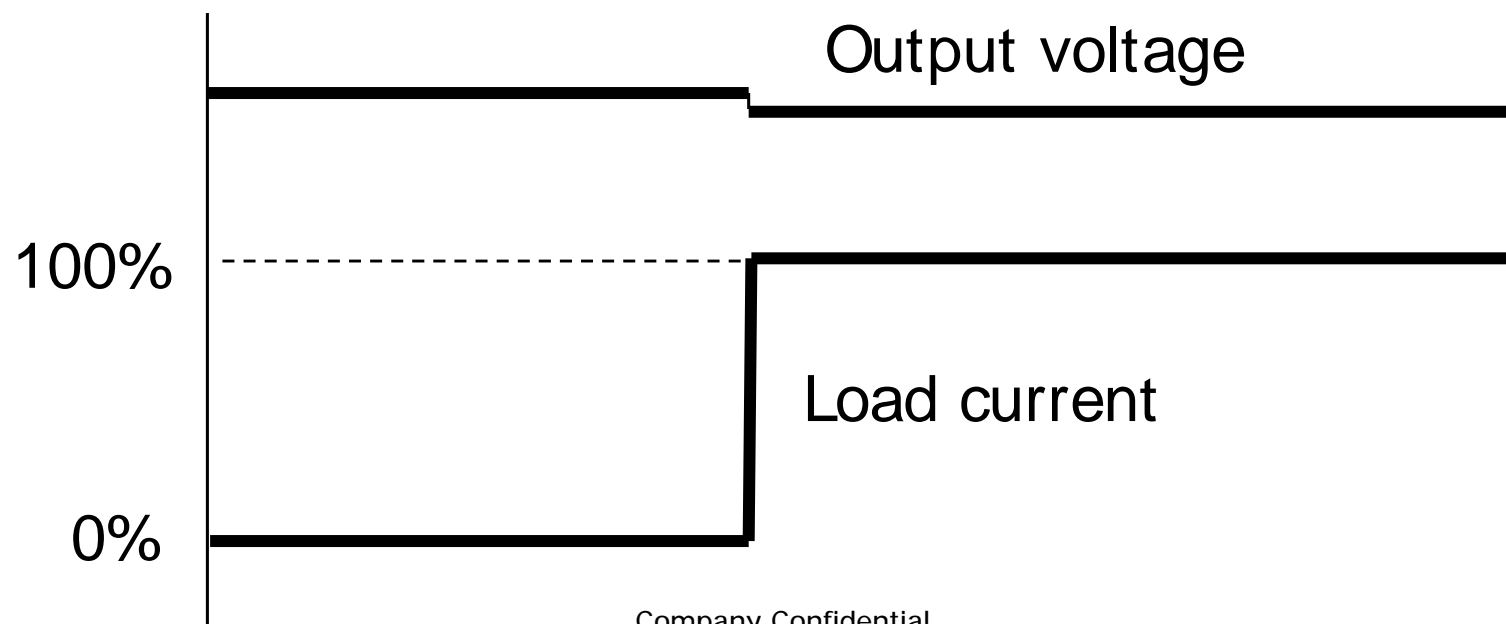
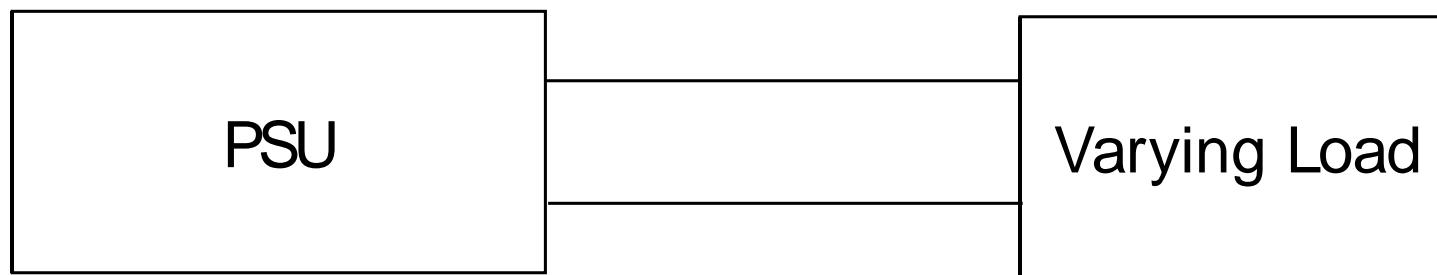
- Different manufacturers use different methods
- 'Paper' specifications not always comparable
- Other may measure in 20 Hz – 200 kHz
- Some do not specify bandwidth at all...

Key Power Supply Specifications

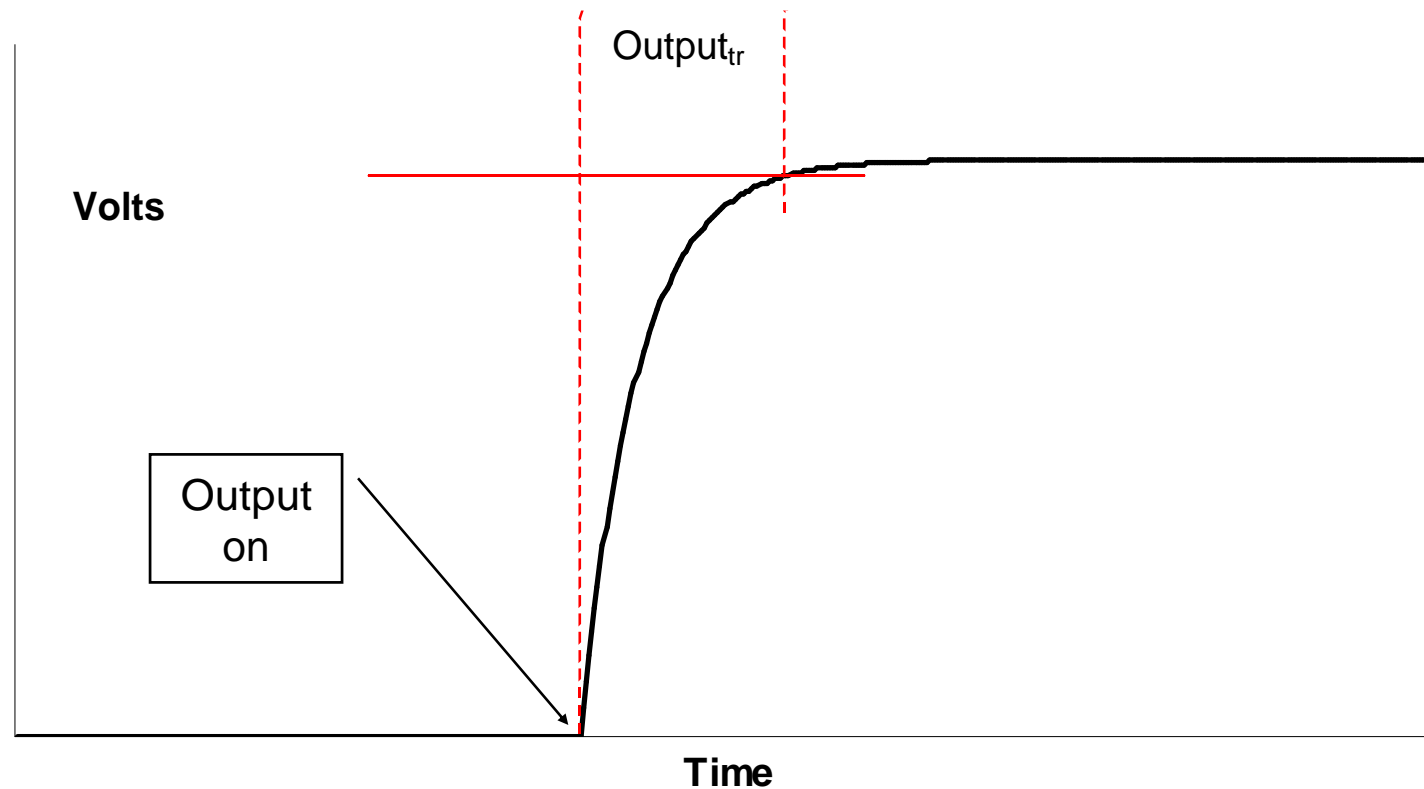
- Load regulation
- Rise time; fall time
- Transient response
- Noise and ripple
- Efficiency
- Input power factor

Load Regulation

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



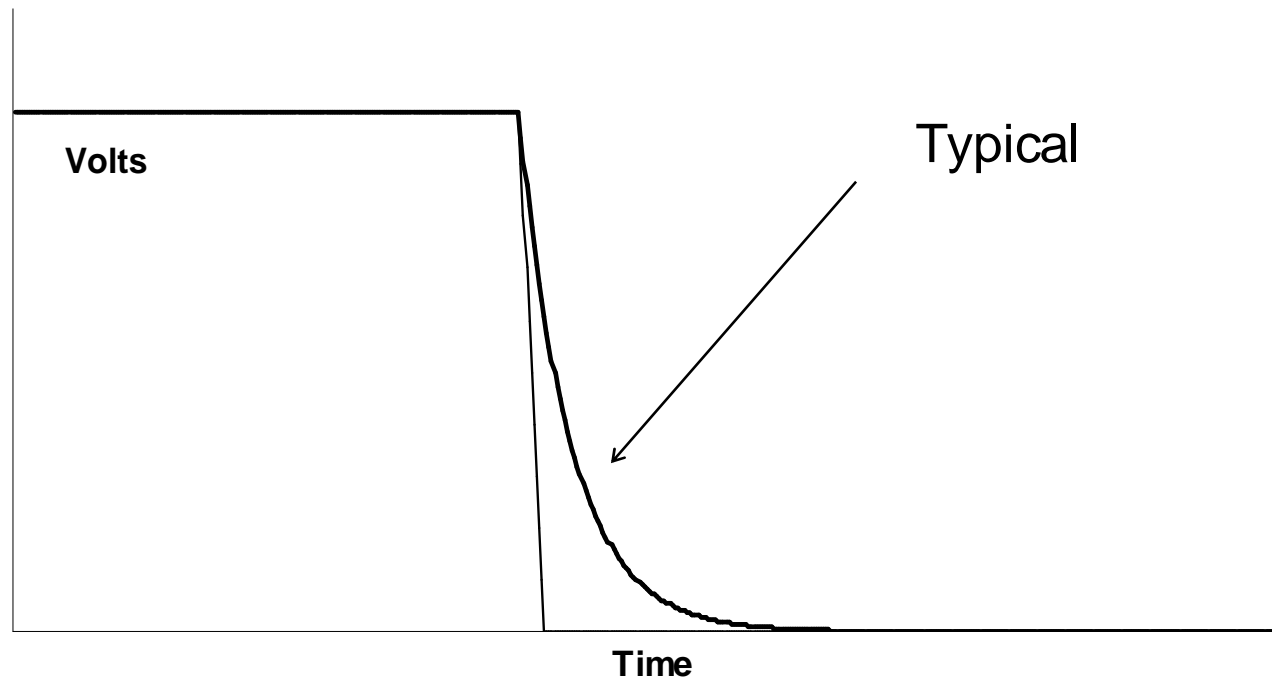
Output Rise Time



Output_{tr} = rise time

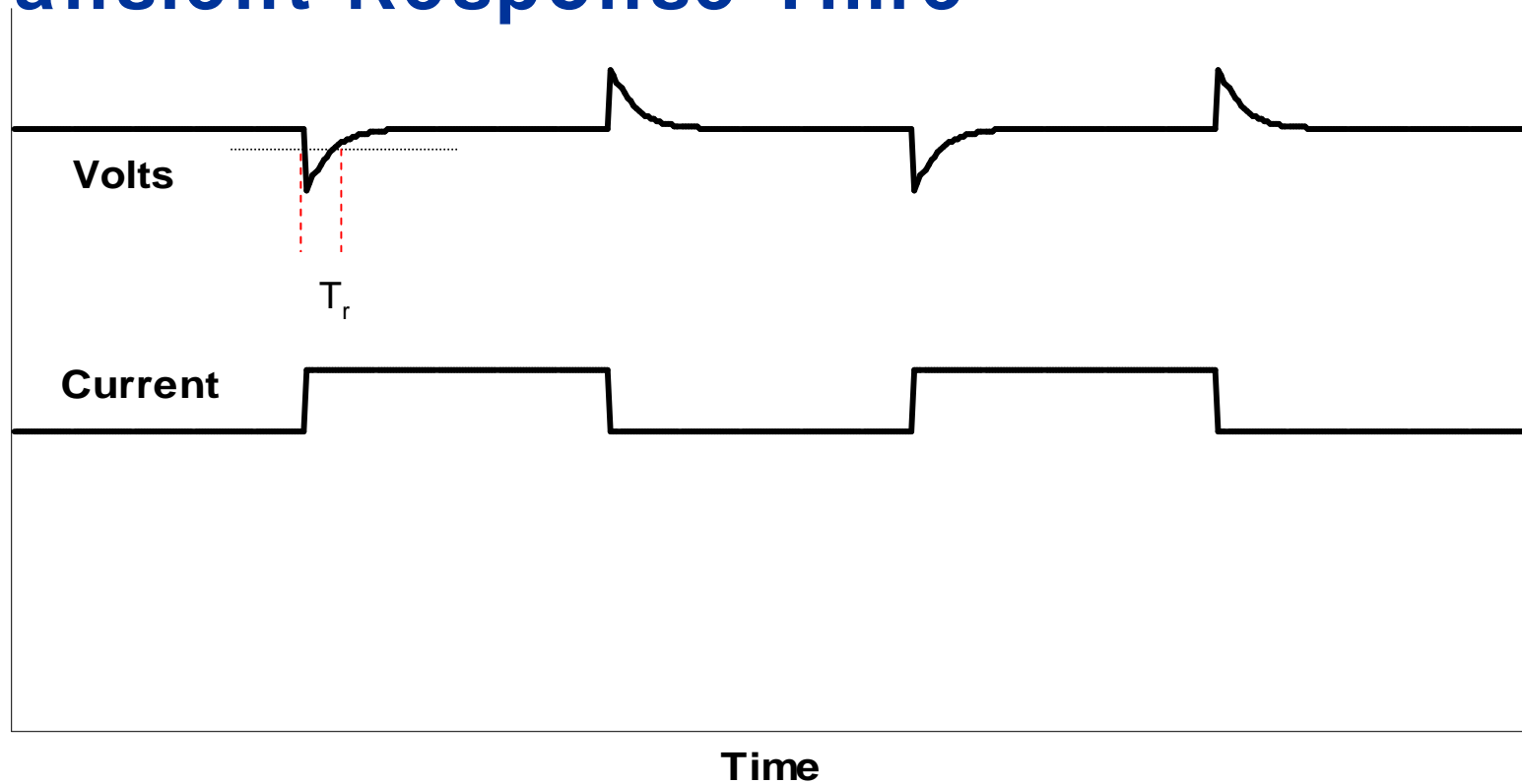
SG Series is 100 ms for 0 to maximum
DC output voltage

Output Fall Time



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

Transient Response Time



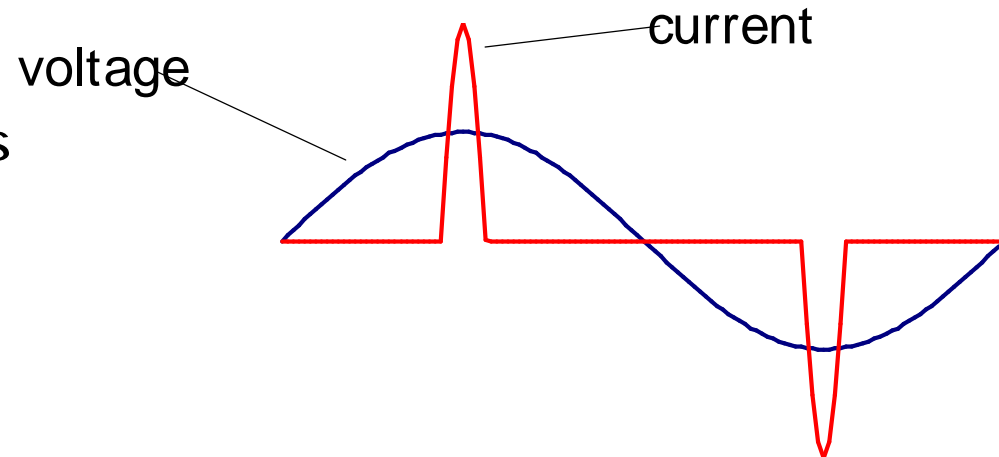
T_r = Transient response time

Typically 1-10 ms

AC Mains Input Power Factor

Bad power factor causes:

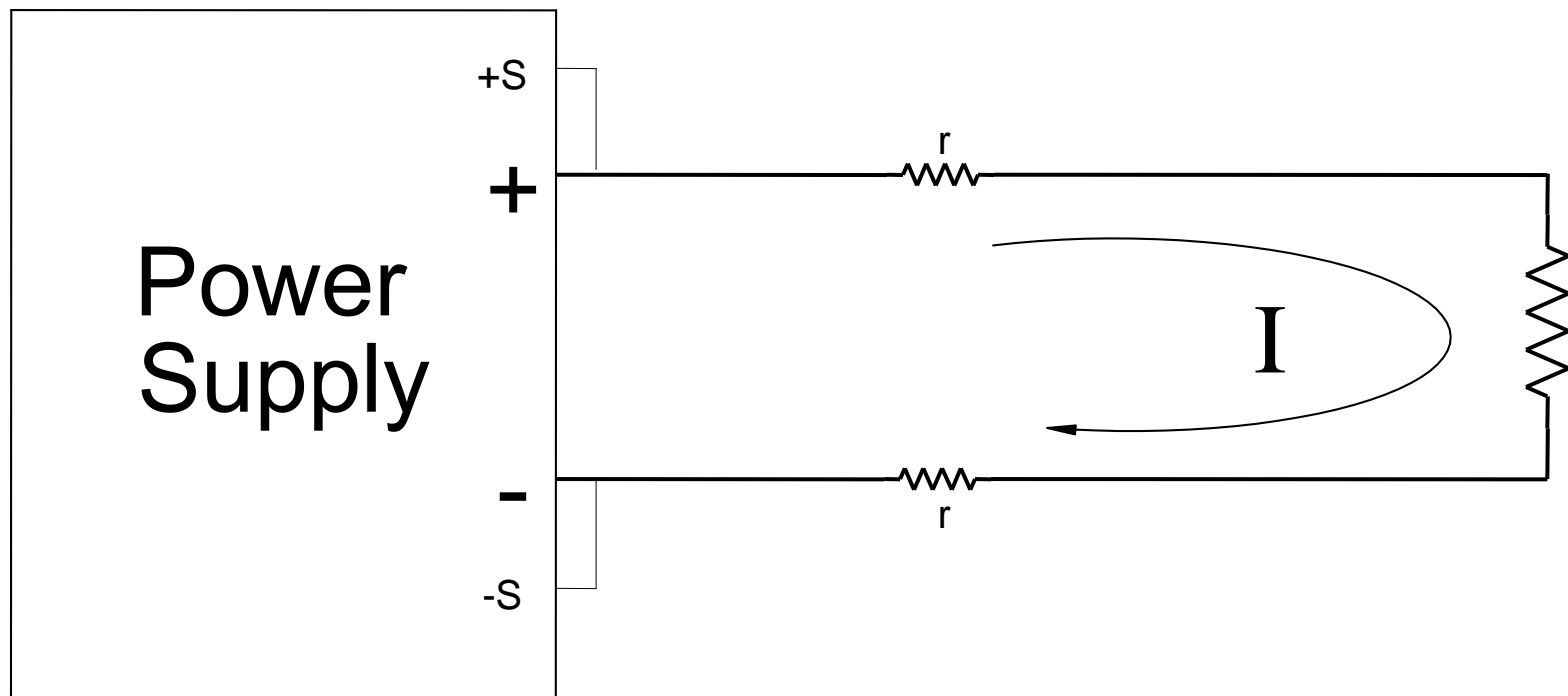
- very high peak currents
 - requires thicker wiring and larger breakers
- large harmonic distortion



Voltage & Current Mode Operation

- PSU switches between CV and CC automatically based on the load
- If $I_{\text{Load}} < I_{\text{SET}}$ = constant voltage (CV) mode
- If $I_{\text{Load}} > I_{\text{SET}}$ = constant current (CC) mode

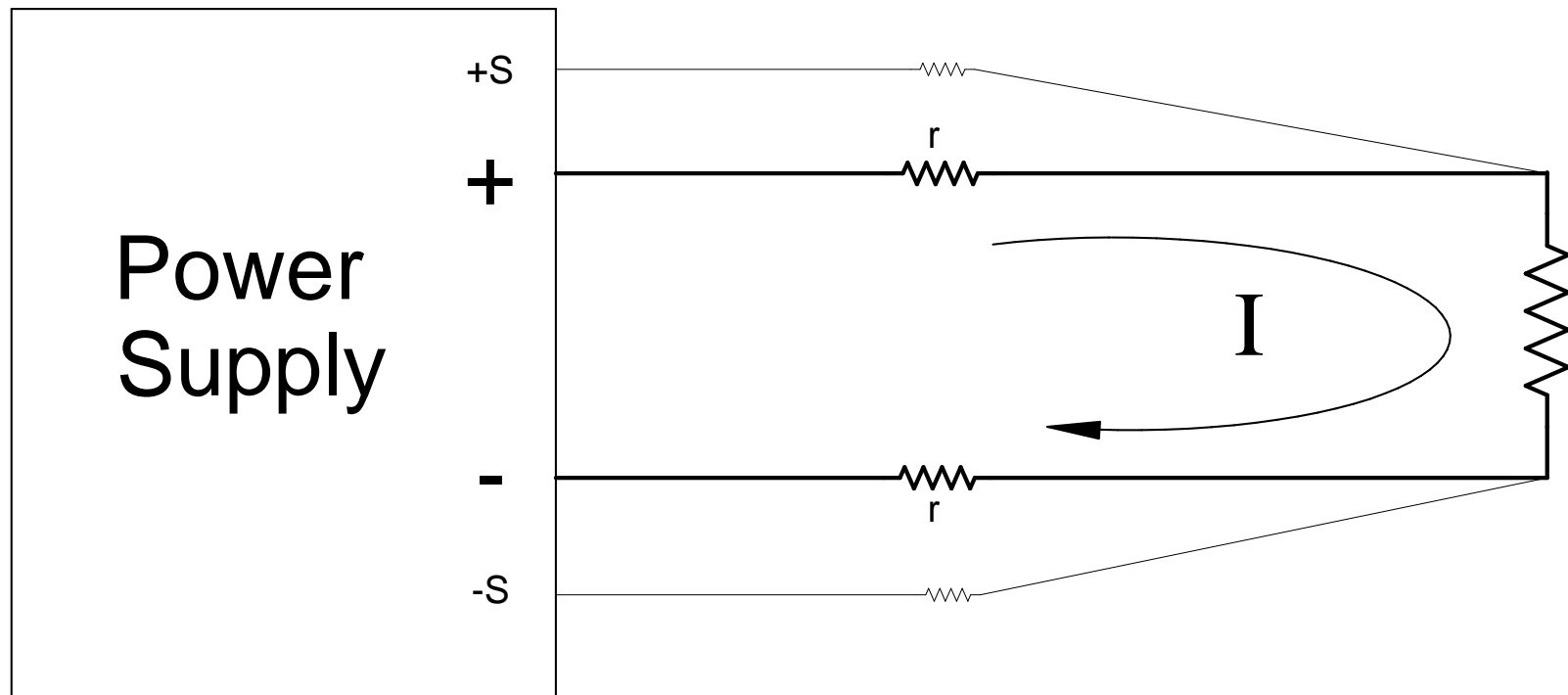
Local Sense Considerations



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

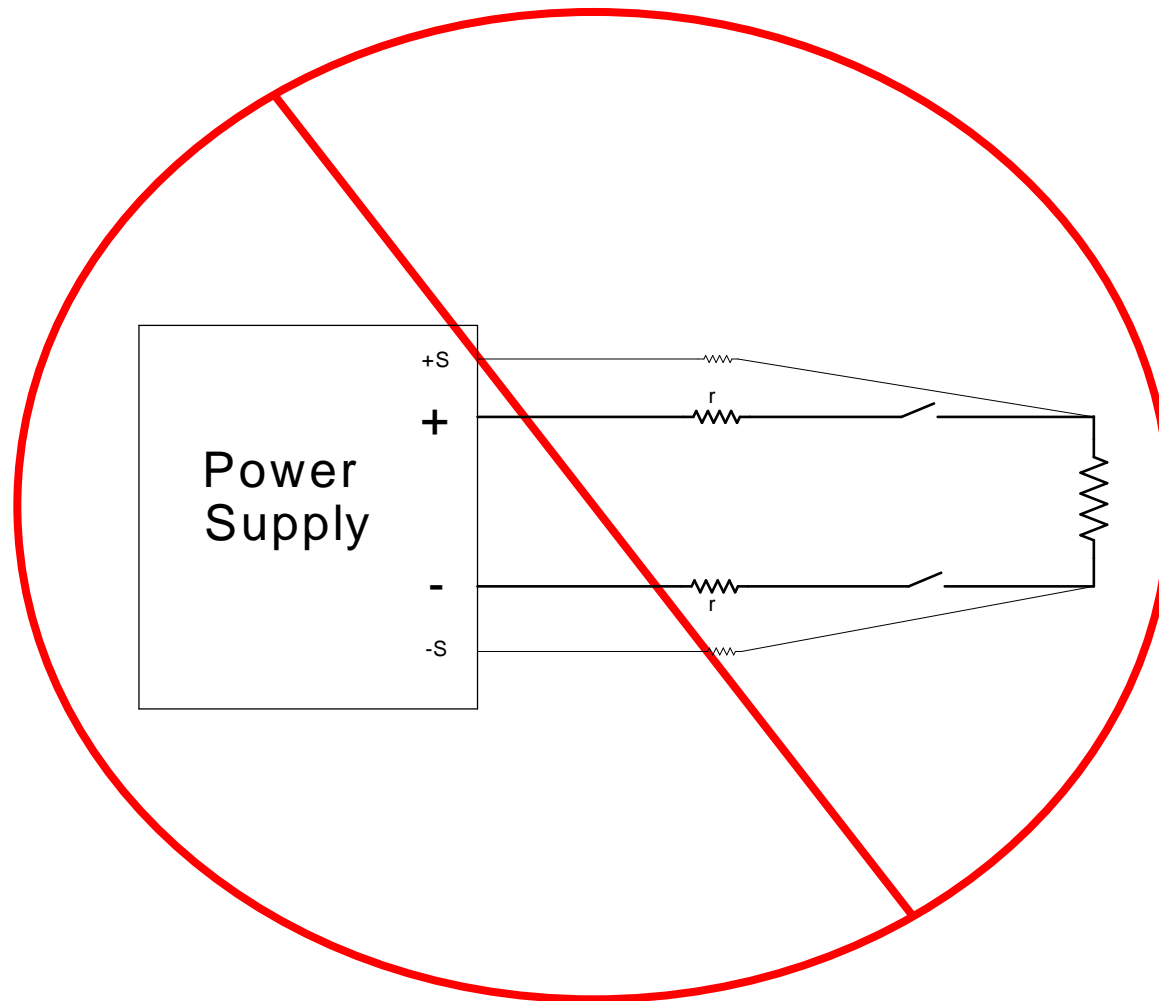
If I = 20 A; $V_r = 20 \text{ A} \times 30 \text{ m}\Omega = 600 \text{ mV}$ drop per line; total 1.2 V!

Remote Sense Considerations

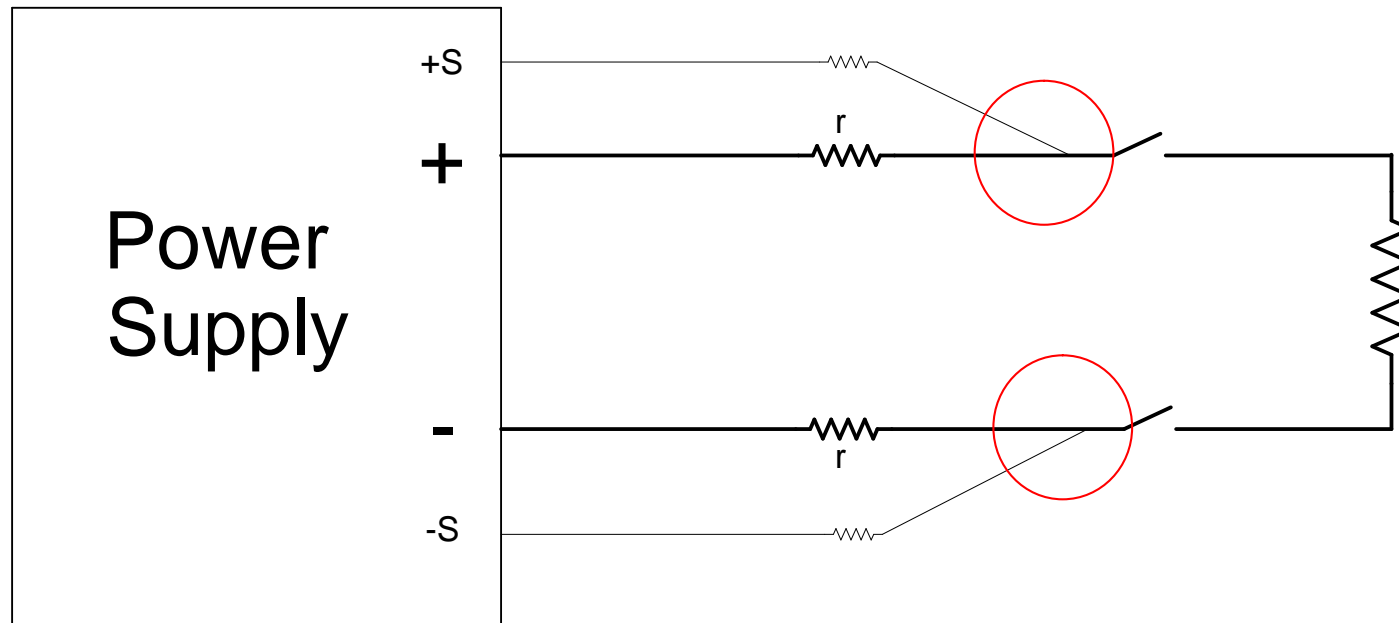


- Advantages:
 - Better regulation at the load
 - Better voltage accuracy

Remote Sense & Load Switching

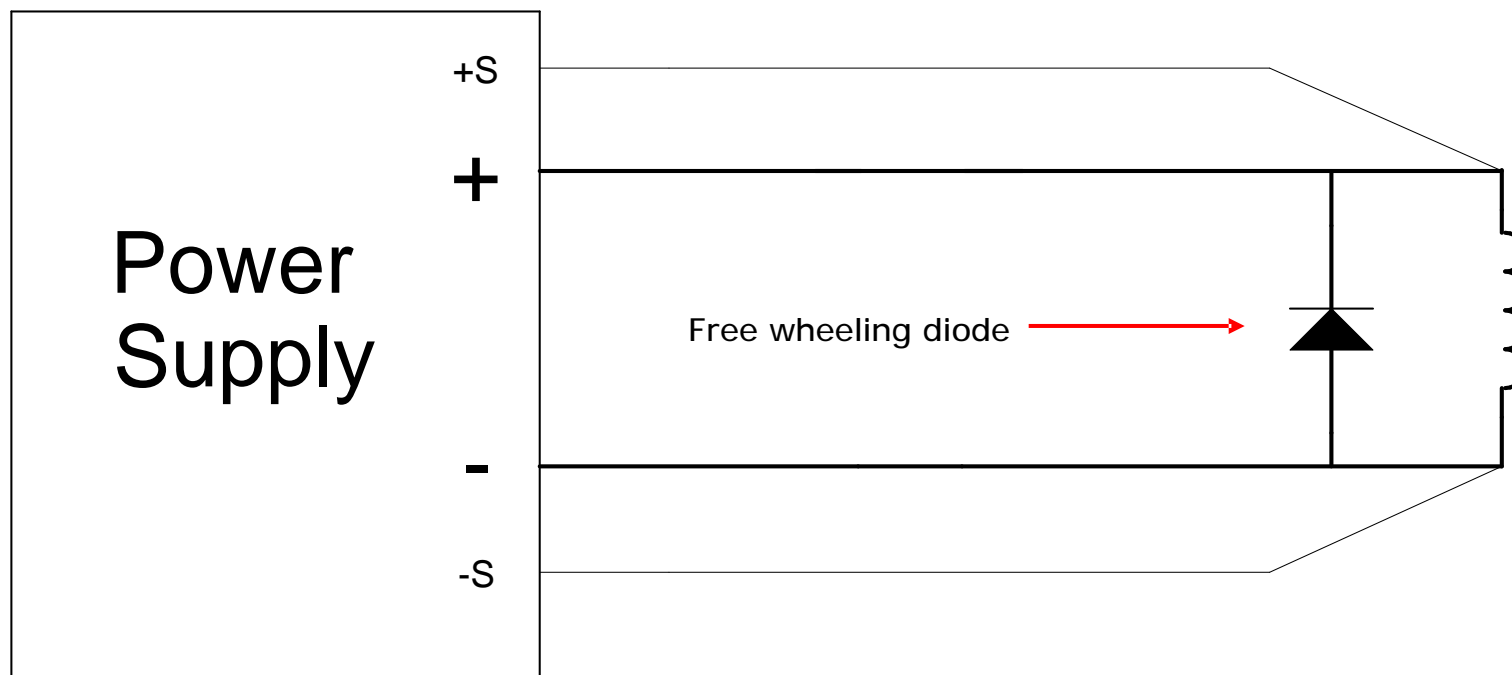


Remote Sense & Load Switching

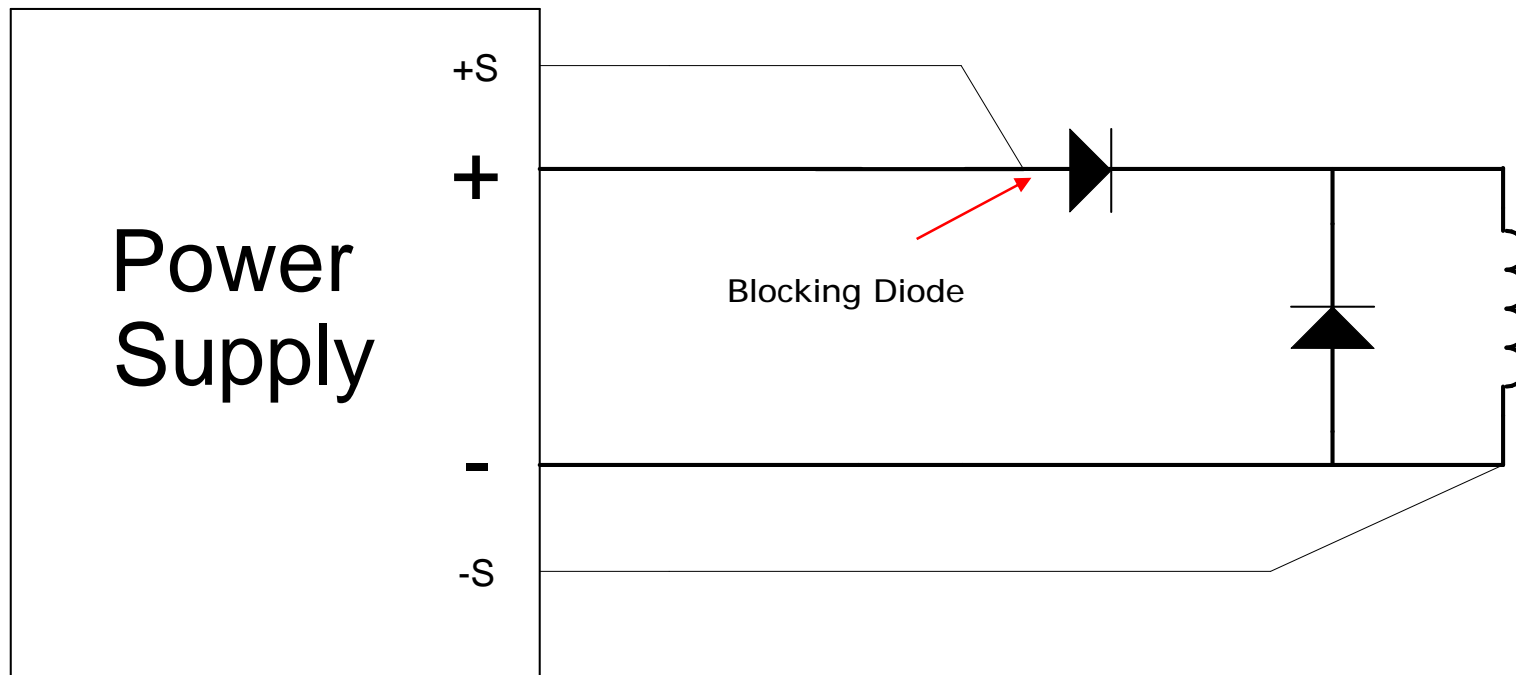


- Correct method:
 - Sense connections on power supply side of switch

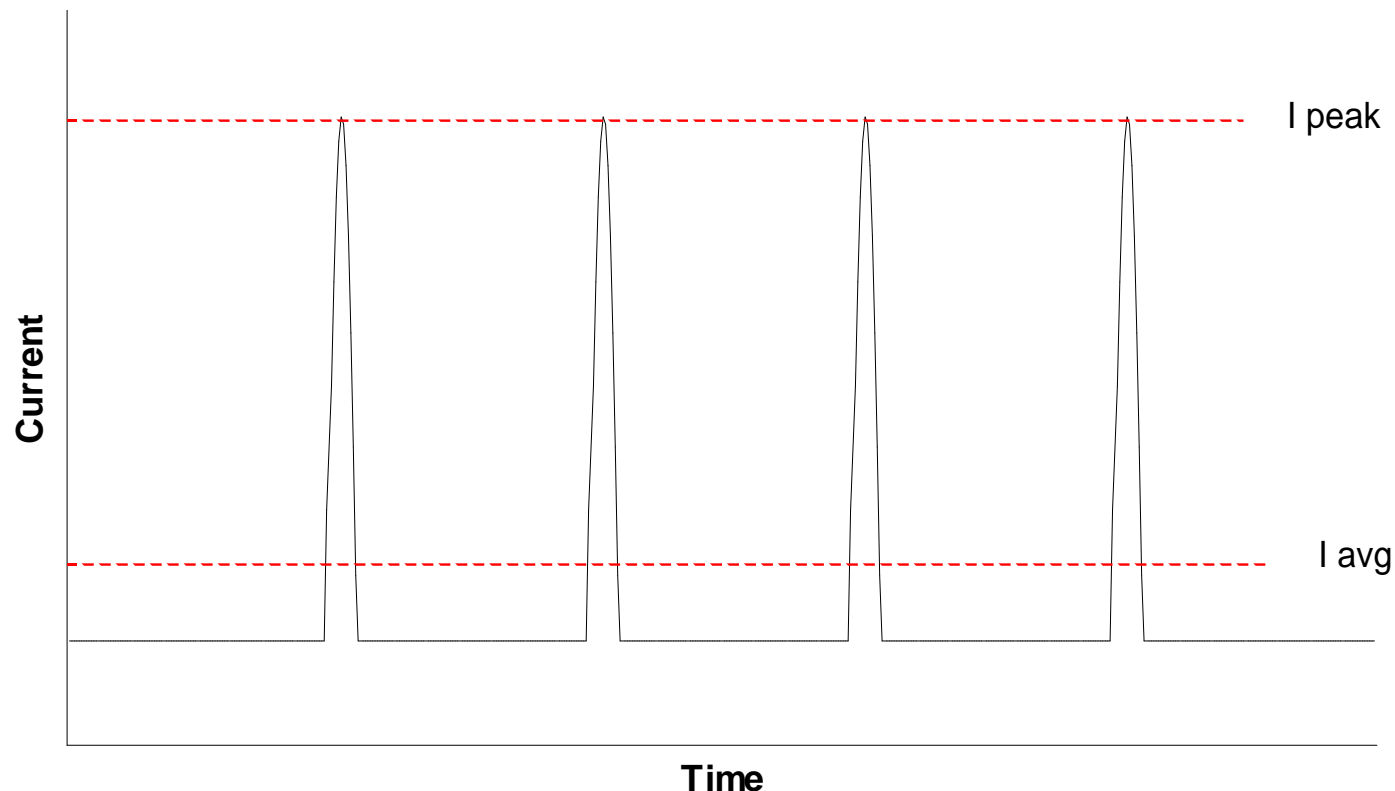
Inductive Load Considerations



Inductive Load Considerations cont'd



Pulsed Loads



Power supply may need to be sized for I_{peak} !

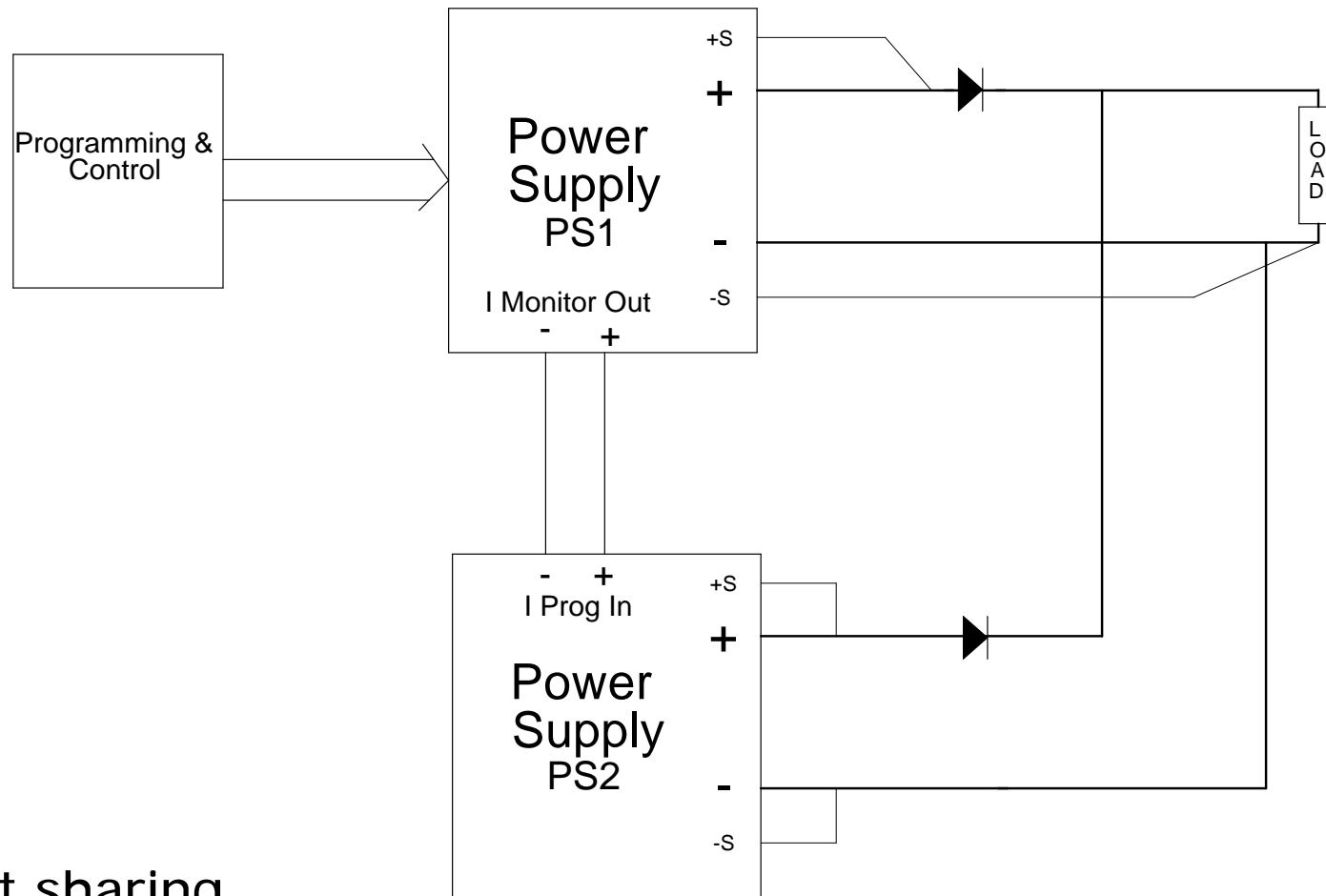
- Typical loads:
 - Inverters (DC \rightarrow AC)
 - DC to DC converters
 - Audio amplifiers

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!

Regulatory

- When using the power as part of a system that will need regulatory approvals it is helpful if the supply meets those approvals too
- Another solution is to have your system approved at the system level
 - Not all components need to be compliant for a system to get approvals, but having compliant components certainly makes it easier

Key Issues with ATE Design

- Mount the power supplies correctly (use rack mount kits and support bars)
- Provide adequate spacing between units (if necessary)
- Provide adequate airflow to the rack (intake and exhaust)
- Provide filtering to air if in a hazardous environment
- Install appropriate AC input breakers
- Provide adequate DC bus (especially if paralleling units) to handle higher currents

Questions?

Thank you!