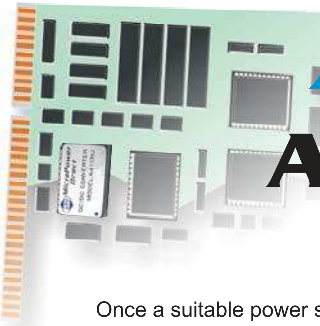


Application Guide
Applying Power Supplies

Once a suitable power supply is selected, equal care must be taken in applying the unit both electrically and mechanically. If good fundamental engineering practices are not followed in the use of power supplies and the layout of power systems, equipment performance and/or reliability will be adversely affected.

Wiring/Connection

The resistance of circuit board traces, wiring harnesses, and connectors can cause unacceptably high voltage drops and/or generate heat if it is too high. This will reduce power supply regulation and in extreme cases (i.e. loose connections) cause failure.

As illustrated in Figure 1, if the printed circuit board trace or wire is not sufficiently large, the regulation performance of the supply degrades. In this example, a power supply is delivering 5VDC at 2A to the load with an output regulation specified at ±0.5%. This gives a specified range of 4.975 VDC to 5.025 VDC (ignoring other possible error sources) that is measured at the load. The 7.83 feet of #18 AWG connecting the supply to the load has a total line resistance of 50 mΩ. The voltage drop across the line resistance is 2% (100 mV) of the power supply output, effectively reducing the output regulation of the supply by a factor of 5, from 0.5% to 2.5%.

AWG	Resistance (mΩ/Foot)	Capacity (mA)	AWG	Resistance (mΩ/Foot)	Capacity (mA)
10	0.998	20,750	24	25.67	808
11	1.261	16,468	25	32.37	640
12	1.588	13,060	26	41.02	508
13	2.001	10,357	27	51.44	403
14	2.524	8,213	28	65.31	319
15	3.181	6,513	29	81.21	253
16	4.020	5,165	30	103.7	201
17	5.054	4,096	31	130.9	159
18	6.386	3,248	32	164.1	126
19	8.046	2,576	33	206.9	100
20	10.13	2,043	34	260.9	79
21	12.77	1,620	35	328.9	63
22	16.20	1,284	36	414.8	50
23	20.30	1,019	37	523.1	40

Table 1: Wire Resistance (Copper)

If this is unacceptable for the intended application, the line resistance must be reduced. This can be accomplished by reducing the distance between the power supply and the load; increasing the wire diameter, increasing the cross sectional area of circuit board traces (or reducing their length).

Proper workmanship standards are required to insure that solder connections are electrically and mechanically reliable. Problems such as microcracking can cause high levels of contact resistance and eventually intermittent operation and even arcing. Edge connectors, terminal strips, etc. should be kept free of dirt, corrosion or tarnish build-up. On power supply outputs where multiple output pins/connections are available to handle high current levels, they should be used.

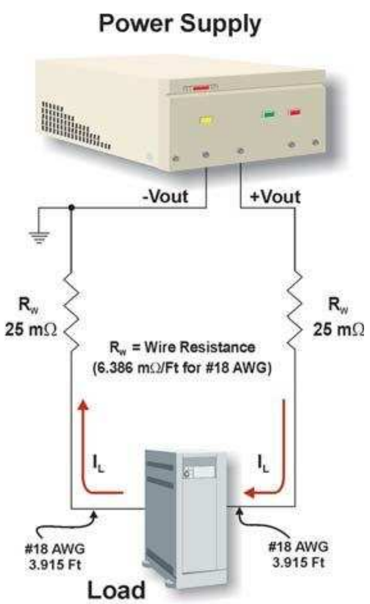


Figure 1: Power Line Resistance

Grounding

Incorrect grounding or power distribution is one of the most common problems in power system design. Poor ground layout can result in a variety of problems (poor regulation, high noise levels, elevated temperature levels, line transients, etc.) that will degrade system performance. The three common power distribution methods are parallel, radial and mixed distribution.

Parallel Distribution: Parallel power distribution (or "daisy chaining") is shown in Figure 2. With this connection, the voltage level seen at each load will vary and DC ground loops will develop. The amount of variation is dependent upon the line IR drops as well as the amount of current drawn by the other loads. If one of the loads is dynamic, the effects of this load interaction is magnified and may cause system instability.

Parallel distribution connections are not recommended for anything other than very low power applications where the line IR drops would be negligible.

Radial Distribution: Radial (or "single-point") distribution is the preferred method to distribute power to

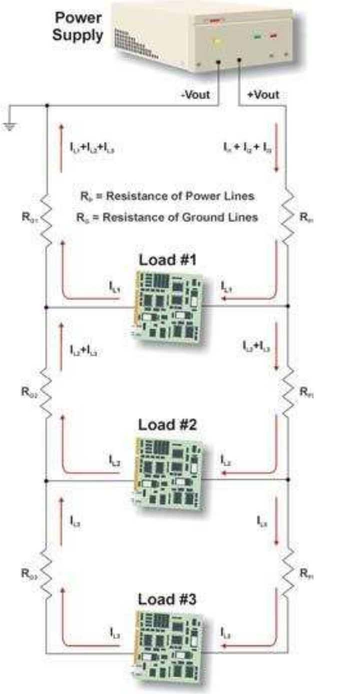


Figure 2: Parallel Power Distribution

MicroPower Direct

Go Direct - For Product, Performance and Price

µPd

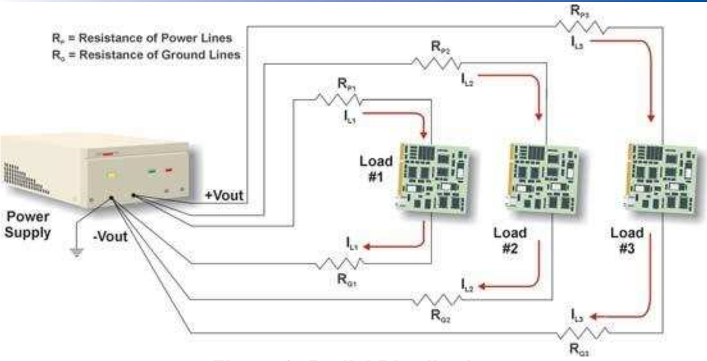


Figure 3: Radial Distribution

the load. As shown in Figure 3, each load in a radial connection forms a separate circuit with the power supply. This eliminates ground loops and reduces any interaction between loads significantly.

The only variation in output voltage across the individual loads is caused by the differing currents drawn by the loads and/or any differences in the individual line resistances.

Mixed Distribution: Practically speaking, a purely radial layout is impossible to achieve in complex electronic equipment. Typically, a mixed radial-parallel system as illustrated in Figure 4 is used.

In this connection, the loads drawing the heaviest current (1 & 2) are located closest to the power supply configured in a radial distribution connection. Loads that draw very little current (in comparison to loads 1 & 2) are located further away from the power supply and are connected in a parallel configuration.

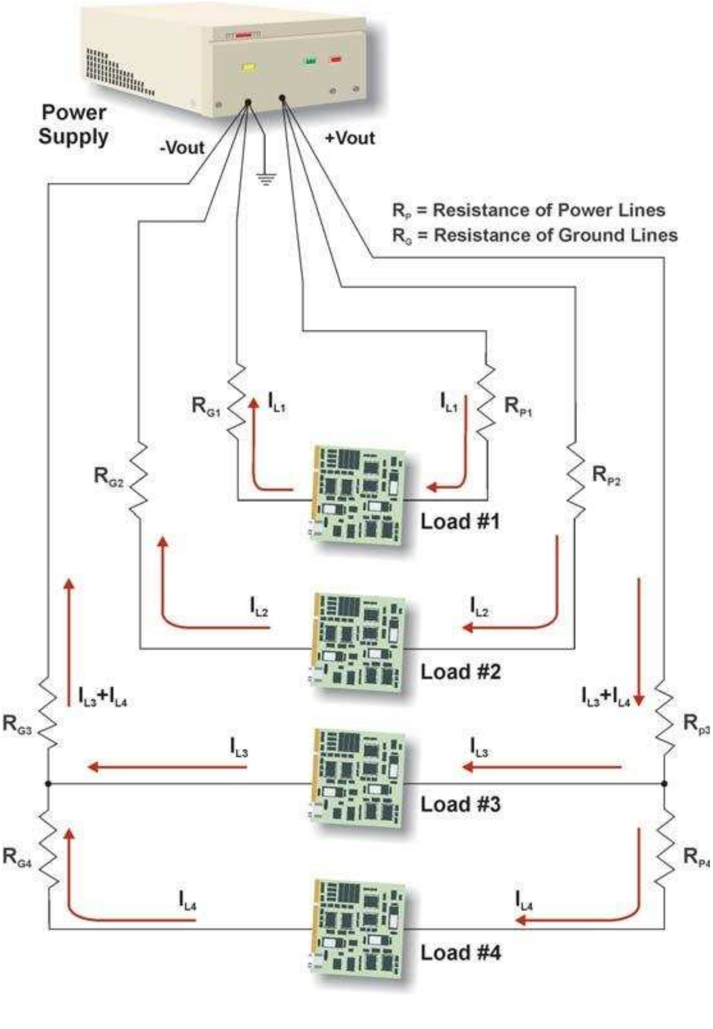


Figure 4: Mixed Power Distribution

Analog-Digital Connection: In many applications, both analog and digital circuitry must be powered. In this type of circuit, it is important to maintain separate power return paths for the analog and digital circuits, as illustrated in Figure 5. Shared returns could cause circulating ground loop currents, logic transients etc. If possible, the grounds should be connected to a single point (preferable chassis ground) to prevent any interaction.

Most triple output power supplies have separate primary (3.3 VDC/5 VDC) and auxiliary (±12 VDC,±15 VDC) output common connections to simplify this type of connection.

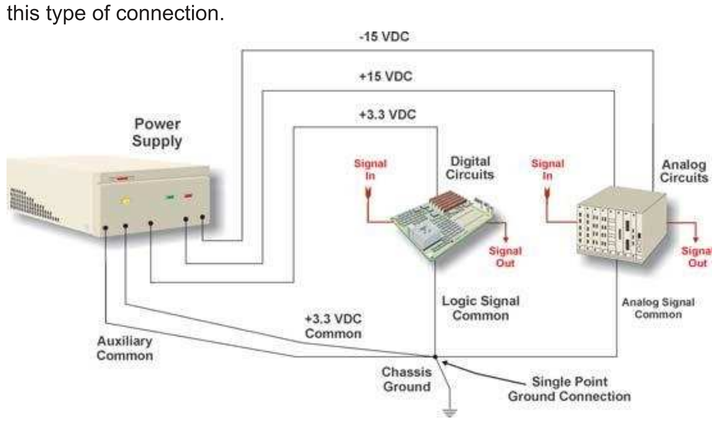


Figure 5: Analog-Digital Connection

Load Decoupling: Power system noise may be induced by the load as well as the power supply. High speed, dynamic analog and digital loads can generate noise spikes across the inductance of the power distribution lines. These loads need small decoupling capacitors added to provide high and low frequency by passing.

As illustrated in Figure 6, a 1μF to 10 μF capacitor (tantulum or electrolytic) is connected in parallel with a 0.1mf capacitor μF (ceramic). The decoupling capacitors should be connected as close to the load as possible.

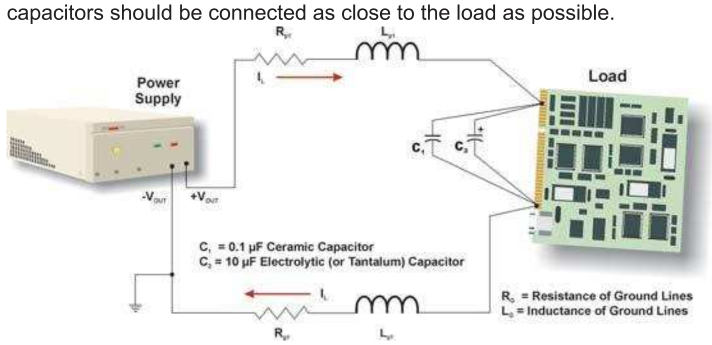


Figure 6: Load Decoupling

Remote Sensing: Many power supplies with high levels of output current offer remote sensing, a feature that helps maintain output voltage regulation. Remote sensing is typically used in applications where the load is located some distance from the power supply and thus is subject to high voltage drops across the line resistance.

With remote sensing, sense leads connected to the output load provide feedback to the power supply as shown in Figure 7. The leads should be connected at the load point where the highest level of regulation is required. The sense leads conduct very little current as compared to the load leads. This input, fed back into the power supply, adjusts the power supply output voltage up to compensate for line IR losses. Typically, the power supply can compensate for up to 0.5 VDC to 1.0 VDC in voltage drops.

Internally, the power supply design will include a resistor or diode connected between each sense input and voltage output. This will prevent an excessive rise in output voltage in the event the sense leads become disconnected from the load.

When using a power supply with a remote sense feature, some general precautions should be taken to prevent problems:

1. The sense leads should be shielded to prevent the injection of noise into the power supply regulation circuit.

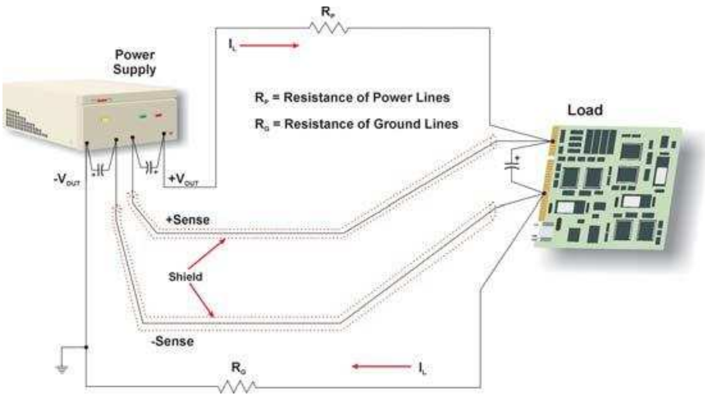


Figure 7: Remote Sensing

2. The transient response of dynamic loads may be limited by the lead inductance of long power lines. The addition of a capacitor, connected across the load terminals, may help. The optimum value of the capacitor will depend upon the specific application.

3. For applications where the load is located some distance from the power supply, instability may be induced by the power lead inductance and bypass capacitance at the load. This can be eliminated by using bypass capacitors between the sense lines and their respective output terminals. A 10 µF tantulum is probably sufficient.

4. If the remote sense option on a power supply is not used, the sense leads should be connected directly to their respective output terminals. If the supply is operated with the sense connections left open, the output will rise (the amount is dependent upon the design). Over time, this could cause damage to the unit.

5. If the sense lines become disconnected or open during operation, the power supply output will jump. The amount of output voltage rise is dependent upon the power supply design. If the power supply output leads become disconnected or open, the full load current will flow through the sense leads. In this case, the power supply output should rise to the OVP point, at which time the supply will shut down.

Input Connection

While power supplies are generally sold as complete subassemblies, most do not include extensive protection circuitry on the input. This is especially true of low and medium power economy models. The addition of a few external components will help insure the continued operation of the supply in the event of a system fault. This is illustrated in Figure 8. Care should be taken not to replicate a feature that is provided by the power supply vendor internally.

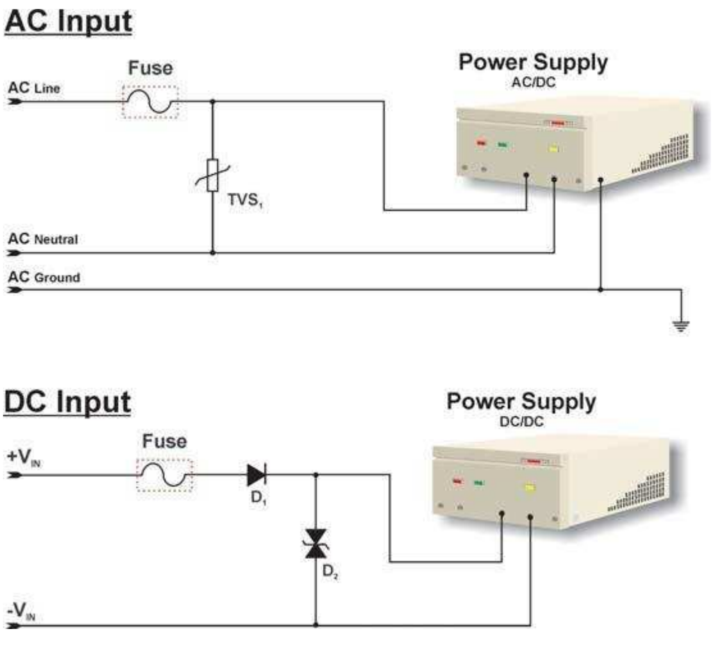


Figure 8: Input Protection

AC/DC Connection: An AC/DC converter has three input connections, as shown in Figure 8. These are the AC-Line (or AC-Live), AC-Neutral and AC-Ground (also called Safety Ground).

The AC-Line and AC-Neutral connections have differing potentials with respect to ground, and should not be interchanged as this could cause circulating ground currents. The AC-Ground connection should be connected to the power supply chassis or the system case/chassis.

DC/DC Connection: DC/DC converters are typically connected with +V Input connected to a positive DC voltage level and the -V Input connected to the power bus ground. Some converters allow a negative input to be connected to the -V input with the +V input connected to power bus ground (typically -48 VDC).

Before referencing the -V input at a potential other than ground, check with the manufacturer. On DC/DCs in metal packages, the -V Input is often connected to the case internally (to reduce noise emissions).

Fusing: It is recommended that the input line to any power supply be fused. In the event of a catastrophic failure within the power supply or system, the fuse will limit input power to the power supply.

Most open frame power supplies will include an onboard input fuse. Encapsulated power supplies typically do not. If a fuse is not included in the power supply design, check with the manufacturer for a recommended fuse size (many vendors include this as part of the product data sheet).

In general, a slow-blow fuse with a rating of twice the maximum input current of the power supply will be sufficient. To calculate the fuse rating, the following equation may be used:

$$I_{FUSE} = \frac{P_{OUT}}{\eta \times V_{MIN}}$$

Where: P_{OUT} = Power supply output power
η = Power supply efficiency
V_{MIN} = Minimum input voltage to the power supply

A slow-blow type will allow the short circuit protection circuitry of the power supply time to react in the event of a transient fault condition. In some applications (some redundant connections, etc.) a fast-blow fuse may be more appropriate. Check with the manufacturer for a recommendation. Care should be taken in the mounting of the fuse to minimize contact resistance. High contact resistance will increase the temperature rise of the fuse, reducing its effective rating (the I^2R drop will also degrade power system efficiency). The fuse should always be connected to the "live" line.

On power supplies that includes an input fuse; the fuse should not simply be replaced in the event of a failure. Typically, an open fuse results from a circuit/component failure. Just replacing the fuse and restarting the circuit could cause further damage to the power supply and/or system. The manufacturer should be contacted and the faulty power supply returned to them for repair.

Power Bus Transients: Momentary voltage spikes on the system power bus can cause damage to the power supply if they exceed the input ratings of the unit. Input bus disturbances have a number of sources including switching transients and ESD transients. To protect the power system, it may be necessary to add external protection as shown in Figure 8. Typically, protection is provided by a Transient Voltage Surge Suppression (TVSS) device. A TVSS component clamps the input to a safe level. A wide selection of TVSS devices are available.

The AC/DC circuit includes a Metal Oxide Varistor (MOV). Under normal operating conditions, the MOV appears as a very high impedance to the input line. For any transient that exceeds the MOV's breakdown voltage the impedance will drop rapidly (typically nanoseconds) and the energy of the transient is dissipated across the MOV.

MOVs are readily available with high breakdown voltages and will handle high power levels. They are moderately fast and relatively inexpensive. A disadvantage of MOV's is that they will degrade progressively after being stressed repeatedly and their response is nonlinear.

The DC/DC circuit shown in Figure 8 includes an avalanche diode (D_2), also called a Silicon Avalanche Diode (SAD). Again, under normal operating conditions, the diode presents a very high impedance to the input line. If its breakdown voltage is exceeded, the impedance of the diode drops and the input to the power supply is clamped to a safe level.

A SAD clamp generally offers very high speed, flat response and higher long term reliability than equivalent MOV devices. They also display much lower leakage currents. They are generally higher in cost and lower in power handling capability then equivalent MOV devices. SAD devices that suffer a failure, will fail in a "shorted" mode.

In selecting a transient suppressor, care must be taken to insure the breakdown voltage exceeds the maximum operating range of the power supply by an appropriate guard band.

Reverse Voltage Protection: DC/DC converter circuits may require reverse voltage protection. In the DC/DC circuit shown in Figure 8, diode D_1 provides protection against power fluctuations that cause a reverse polarity on the input but do not open the fuse. Under normal operating conditions, D_1 is forward biased. In the event the input swings to the opposite polarity (due to a fluctuation or fault condition on the input bus), the diode will reverse bias, blocking any current flow.

The diode should be chosen to remain forward biased over the full input range of the converter (plus a suitable guard band) and be rated to withstand twice the maximum input current. Since any IR drop on the input line will degrade the efficiency of the power system, D_1 should be a Schottky type diode with a very low forward voltage drop.

Bulk Capacitor: Some power supplies (typically DC/DC converters) require a bulk capacitor connected across the input. This capacitor attenuates voltage spikes caused by the power supply's reflected ripple current; provides some "hold time" in the event of a transient power bus failure and/or matches the input impedance of the power supply to the power source.

If the capacitor is being used to provide a "hold time", its approximate size can be estimated by the formula:

$$C_H = \frac{I_{INAV} \times T}{V_{IN} - V_{MIN}}$$

Where: I_{INAV} = Average input current to the converter
T = Time it takes the hold capacitor voltage to fall to the minimum level required to operate the power supply
V_{IN} = Input bus voltage
V_{MIN} = Minimum input bus voltage

Check with the manufacturer concerning the need for an input bulk capacitor and its optimum value.

Inrush Current Limiting: Many power supplies feature internal input filters that include capacitors connected directly across the input terminals or require the connection of an input bulk capacitor. When power is initially applied, the power circuit will draw large input currents as these capacitors charge (this is especially true in the case of "Hot Plug" applications where a power system may be connected to a live power bus). This is illustrated in Figure 9.

The input current is equal to (for input rise times of up to about 10 mS) :

$$I_{IN} = \frac{V}{R}$$

Where: V = Input voltage level
R = Resistance of the input circuit, including line resistance, component resistance and capacitor ESR.

Thus, for a 12 VDC input DC/DC converter with an input line resistance of 100 mΩ, the instantaneous input surge current could be as high as 120A (assuming the input is switched instantaneously and the power source could supply it). In practice, input surge levels are much lower.

Most higher power supplies (that would in turn be potentially subject to high inrush currents) include internal inrush limiting circuitry. This often takes the form of a "soft start" circuit, that gradually brings the power supply on-line after the input voltage is applied. If the power supply does not include inrush

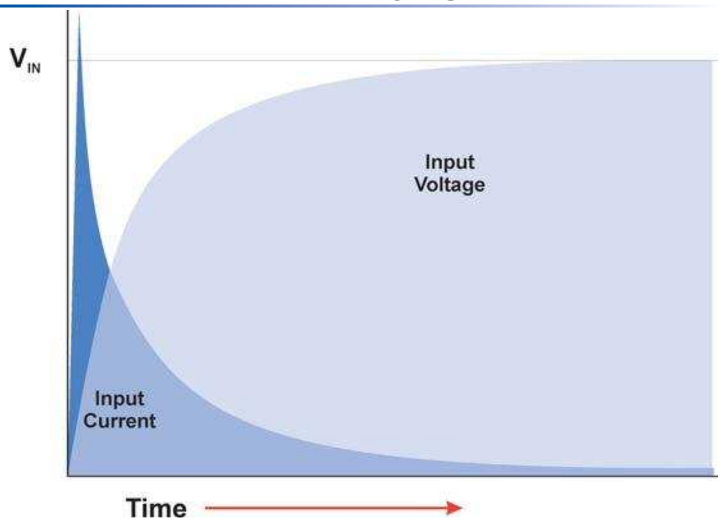


Figure 9: Input Current vs Input Voltage

current limiting internally, and it is considered a potential problem for the application, contact the manufacturer for a recommended solution.

Remote ON/OFF: A feature on many power supplies is the ability to turn them on or off remotely. This feature is particularly useful for mobile or battery driven applications where power conservation is critical. The signal is typically TTL/CMOS compatible and may use positive or negative logic; check the product data sheet to be sure.

High leakage currents or spurious noise may cause false triggering of the Remote ON/OFF function. The circuit shown in Figure 10 includes capacitor C_1 and resister R_1 to couple noise to ground. Capacitor C_2 provides high frequency decoupling in noisy environments. Circuit paths should be kept as short as possible

The Remote ON/OFF function may also be used to control the turn-on/shutdown sequence of a power system. If the option is not used, the Remote ON/OFF input must be referenced appropriately (logic high or low) to insure that spurious noise or transients do not inadvertently trigger the function.

External Clock Synchronization: Many power supplies allow the synchronization of multiple units. This is particularly useful in some distributed power applications to help reduce power system noise. Typically, this feature takes advantage of the sync input to the power supply PWM IC. The frequency of the PWM oscillator is locked to the external clock or the clock frequency of another power module.

The external clock frequency should be within 10% of the free-running frequency of the power supply PWM oscillator (set by the power supply manufacturer). When using this type of connection, provision should be made for the event of a fault condition that results in the loss for the clock signal to one or more supplies. Contact the manufacturer for recommended protection circuits.

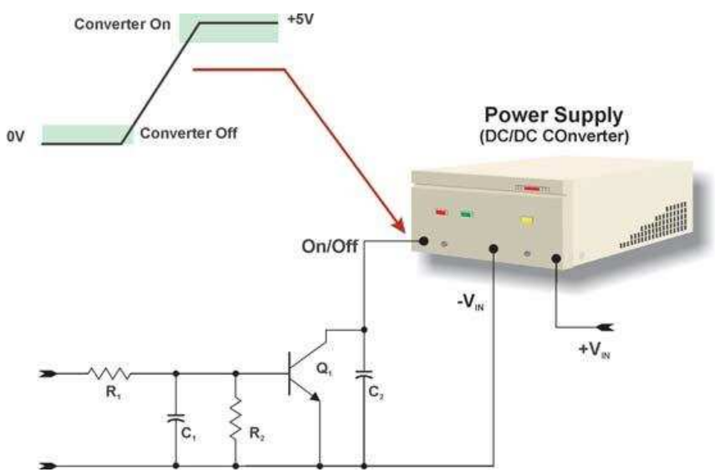


Figure 10: remote ON/OFF

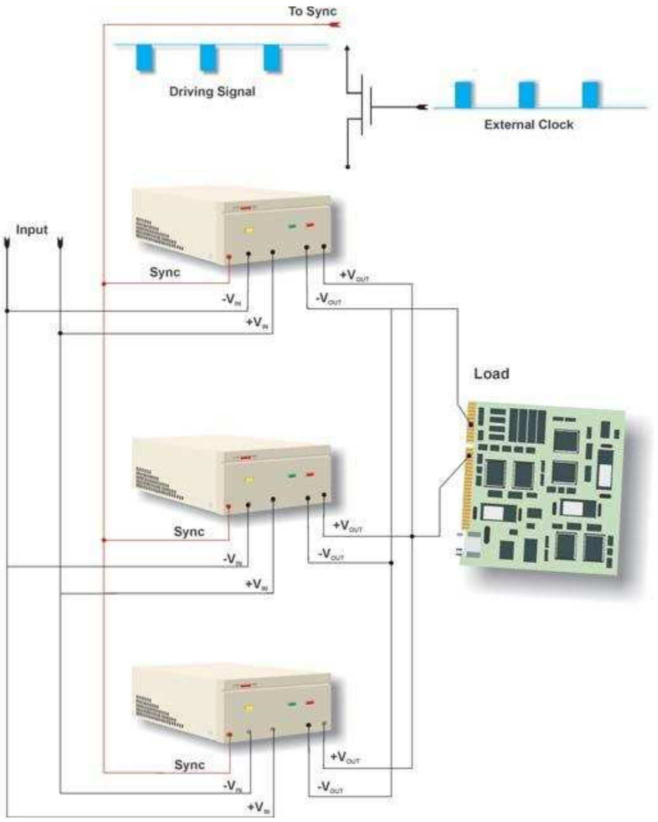


Figure 11: External Clock Connection

Filtering

Power systems generate noise which needs to be filtered or suppressed in many applications. Most electronic equipment must meet regulatory standards for electromagnetic interference (EMI). Although typically not directly applicable to component subsystems such as power supplies, manufacturers often include internal filters and test product to generic standards.

The noise generated by a power system takes on two forms:

> **Conducted:** Noise generated by a power supply (typically by the switching action of the control circuit) and reflected back onto the input power bus and/or other system circuitry.
>
> **Radiated:** Noise generated by a power supply (typically by the switching action of the control circuit) that is capacitively coupled to the case, heat sinks, etc. of the power supply. It is then emitted into the area and/or circuitry surrounding the power system.

While these noise levels cannot be fully eliminated in a practical system; they can be reduced to conform with applicable agency limits. The typical agency standards used for power supplies are shown in Table 2.

Input Filtering: Input filters are added primarily to reduce the effects of conducted emissions caused by the switching noise reflected or "kicked" back onto a power bus by the power supply circuit. The robustness and complexity of an input filter will vary tremendously from application to application.

A typical input filter is a combination of inductive and capacitive components that attenuate high frequency noise while passing low frequency operating currents. Filters are designed to block both common & differential mode noise.

> **Common Mode Noise:** The noise component that appears as a voltage on both power supply input connections with respect to safety or earth ground. Current flows through both lines to ground (or through circuit capacitance to ground if there is no direct connection).
>
> **Differential Mode Noise:** The noise component that appears as a voltage between the input connections to the power supply. Current flows through the input lines and the power supply. No current flows in the ground connection.

	Class A	Class B
FCC CFR Title 47 Part 15	Computing/Information technology equipment for use in industrial, commercial or business applications. Over frequency range of 450 kHz to 30 MHz.	Equipmet for use in residential environments. Over frequency range of 450 kHz to 30 MHz.
CISPR 22 EN 55022	Information technology equipment which meets conducted line emissions from 150 kHz to 30 MHz. Equipment may be subjected to sales restrictions for use in some countries.	Information technology equipment which meets conducted line emissions from 150 kHz to 30 MHz. Equipment is not subjected any restrictions on its use.

Table 2: EMI Regulations

The filtering of common mode noise requires the connection of capacitors ("Y" Capacitors) to safety ground or earth. Safety regulations regarding leakage currents require that these capacitors be a very low value (which in turn requires that inductive components be of relatively high values to achieve effective filtering). The filtering of differential mode noise requires the connection of capacitors across the power supply input lines ("X" Capacitors).

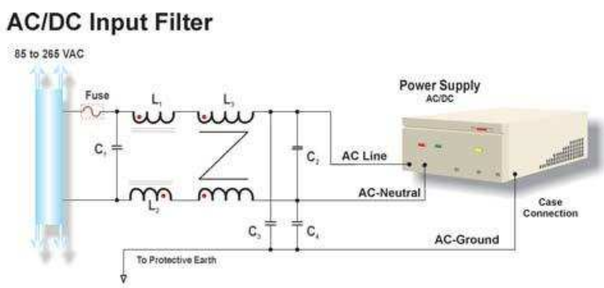
Figure 12 illustrates typical external filter configurations for use with AC/DC and DC/DC power supplies.

AC/DC: The AC/DC power supply has a multistage input filter that includes common and differential mode components. Common mode EMI is coupled by the low impedance path that Y capacitors C_3 and C_4 provide to ground. The common mode choke (L3) presents a high impedance to common mode noise, limiting current flow to the power bus.

Differential mode noise is coupled away from the power bus by capacitors C_1 and C_2. Differential mode chokes L_1 and L_2 present a high impedance to differential mode noise, further limiting current flow back to the power bus.

DC/DC: Most DC/DC converters include an internal Pi (π) filter which will attenuate differential noise. As shown in Figure 11, a common mode filter may be added externally to further attenuate noise conducted back to the power bus.

The leakage current through filter capacitors to ground is limited by regulatory agencies for safety concerns. The "Y" capacitors used in filters are limited to low values for this reason. The "X" capacitors used in filters are not limited in size, however, values over 0.1 μF require a discharge resistor to eliminate



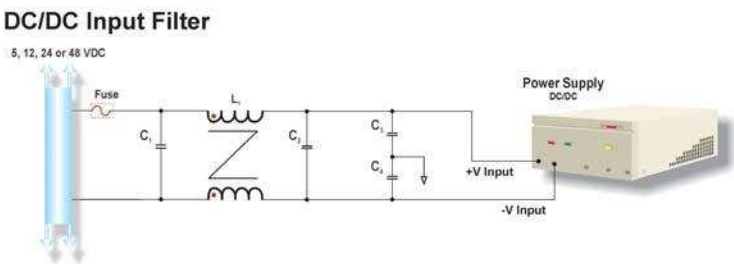


Figure 12: Input Filtering

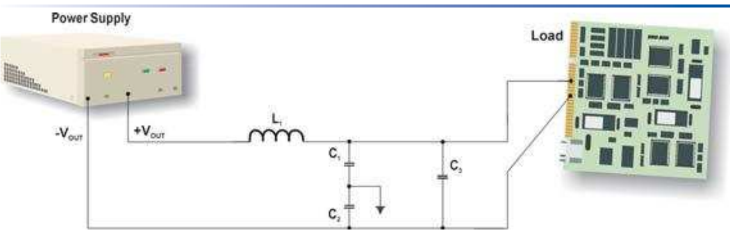


Figure 13: Output Filtering

electrical shock hazard.

Output Filtering: The output filter included in most power supplies reduces output noise and ripple sufficiently for the majority of applications. For noise critical applications a simple LC type filter as shown in Figure 13 may be added. In the case of 1W DC/DC converters offered by MicroPower Direct, the addition of an LC filter with values of approximately 4.7 µH and 4.7 µF, will improve output noise by a factor of 4.

Shielding: Radiated emissions are typically limited by careful magnetics design, good circuit layout and shielding. Shielding is used on critical components and for higher power units, the power itself (in the form of a metal case). Connection to the case is often provided (on DC/DC converter modules via a pin). This case or chassis can then be set to ground potential by connecting it to the input or output return. For board mount power supplies, it is recommended that a ground plane be incorporated on the pc board under where the converter will mount. Running signal traces under a converter should be avoided.

All decisions on case potential, shielding and\or board layout should be made with system noise requirements in mind. Contact the manufacturer for any assistance.

Output Connection

Dependent upon the application, the power supply output can be connected in a number of ways. Again, care must be taken not to replicate a feature that is provided by the power supply vendor internally.

Output Trim: Many power supplies allow the user to adjust or "trim" the value of the primary output. On AC/DC units, this is typically accomplished by providing an adjustable potentiometer that is assessable to the user (typically near the output connector or on the front panel).

Encapsulated DC/DC converters that include a trim option typically require an external trim network. This is shown in figure 14. These converters will have a "trim" output pin. As shown, discrete 5%, ¼W resistors connected between the output trim pin and +VOUT (trim down) or -VOUT (trim up) may be used or a 10 kΩ potentiometer (connected as shown) may be used.

The capacitor shown in Figure 14, is for noise decoupling. This is especially important if long leads are used to connect to the trim resistors or potentiometer. The value of this capacitors should be low to avoid any instability problems. Shielded wire could be used to connect the trim resistors or poteniometer wiper arm to the trim pin as an alternative.

Output Series Connection: To increase flexibility, or achieve output voltages not commonly available, users will sometimes use dual output power supplies connected to provide a single output voltage.

A series connection of a dual output power supply is shown in Figure 14. In this supply, the isolated dual outputs are already connected in series with a common output pin. In this case, a ±12 VDC output power supply is used. The output common is floated and the load is connected across the $+V_{OUT}$ and $-V_{OUT}$ terminals, giving +24 VDC. In this way, outputs of 10 VDC, 18 VDC, 24 VDC, or 30 VDC can be to achieved quite simply from standard dual output power supplies. Diodes D_1 and D_2 provide protection against a

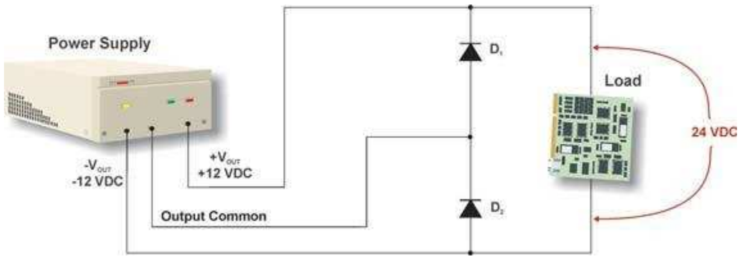


Figure 15: Output Series Connection

reverse polarity on the output (this could occur if the outputs do not come on simultaneously).

Minimum Loading: Most power supplies require a minimum load be placed on each available output in order to maintain operating specifications. The minimum load requirement is typically 10% to 20% of the full output load rating.

If the power supply is unregulated (typical of many 1W and 2W DC/DC converters), operating a 0% load will cause the output voltage level to rise. The amount of this rise is dependent upon the design, but could be significant enough to cause damage to the supply. A regulated power supply is operated below minimum load requirements, problems encountered could range from a loss of output regulation to instability.

Most manufacturers now specify minimum loading requirements on product data sheets. If the application does not draw at or above the specified minimum load current requirement, preloads (typically a resistive load) should be considered. If preloading the outputs is not feasible, contact the manufacturer for advice.

Capacitive Loading: Most applications include some level of capacitance on the output. This includes decoupling capacitors, filter capacitors, etc. If this capacitance level is too high, it can cause a fault condition when the power supply starts up.

This is because at turn-on, the output capacitors will draw high current levels as they charge. If too high, this will drive the power supply beyond its current limit point, shutting it down. Many manufacturers now publish capacitive loading capability for their power supplies. If this specification is missing or there is a question as to the application being driven, contact the manufacturer.

Multiple Power Supply Connections

Power supplies are often connected in multiple unit configurations to achieve higher output voltage levels, higher output power capability or to achieve higher system reliability.

Series Connection: Figure 16 illustrates two power supplies connected in series to provide a higher output voltage level (similar to the single module series connection). Although fairly common, care

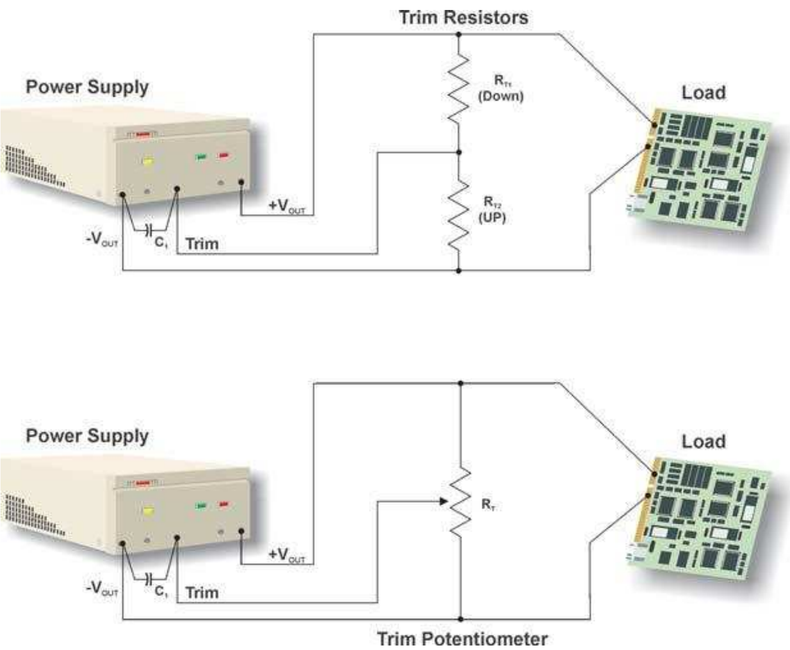


Figure 14: Output Trim

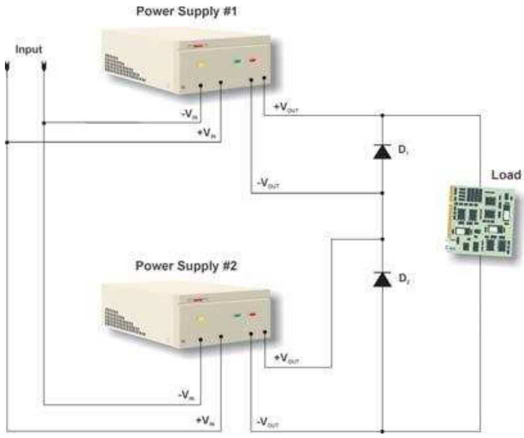


Figure 16: Series Connection, Multiple Units

must be taken when connecting power supplies in series to prevent problems:

1. The output ripple & noise of the power supplies is additive unless the supplies are operating synchronously (see External Clock). This may require more robust output filtering

2. The total output voltage should not exceed the working breakdown of any one of the power supplies. This value may be less than the rated isolation level of the supply.

Diodes D_1 and D_2 provide protection against a reverse polarity on the output (this could occur if the outputs do not come on simultaneously).

Parallel Connection: Parallel connections are used to increase reliability (see Redundant Connections) or increase output power. However, connecting power supplies in parallel is more complex and prone to problems than a series connection. In fact, it is not recommended that this type of connection be attempted unless the power supplies are specifically designed for it.

The problem is in equally sharing the load current. Two "standard" power supplies will have a slight variation in output voltage. In a parallel connection (assuming the units do not include internal load sharing circuits), the unit with the higher output voltage will try to provide the full output current. Obviously, this will result in a failure of the power system. In some low power applications (where loadsharing power supplies are not available) units are sometimes connected in parallel by precisely trimming the outputs. This is still not recommended as over time and temperature the outputs will drift and the system will likely fail.

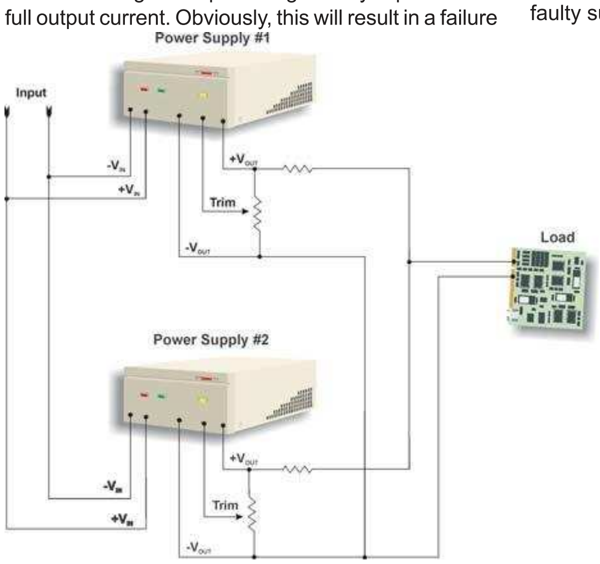


Figure 17: Parallel Concection, Multiple Units

Redundant Connections: As stated, power supplies are often connected in parallel to provide redundancy in the power system, thus increasing system reliability. There are a number of ways to achieve redundancy, including dual redundant, master slave and N+1.

Figure 18 illustrates a dual redundant (100% redundant) connection utilizing "oring" diodes. In this connection, the output of power supply #1 (as measured at point "A") is set to the output of power supply #2 (as measured at point "B") plus the forward drop across D_2. As long as power supply #1 operates normally, D_2 will be reverse biased and power supply #2 will be disconnected from the load.

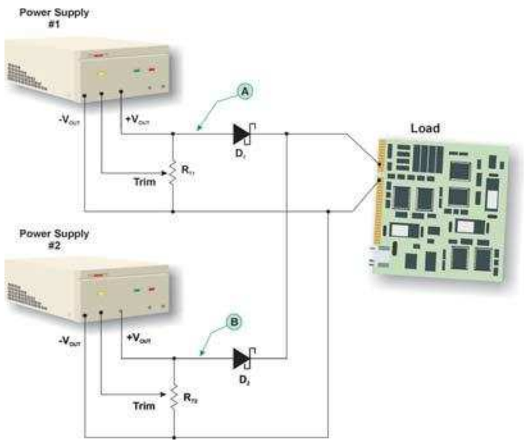


Figure 18: Dual Redundant Connection

If power supply #1 fails, the output at point "A" drops. The oring diode D_2 then becomes forward biased and power supply 2 will begin to provide power to the load. Diode D_1 is then reverse biased, disconnecting the faulty supply (#1) from the load.

Other parallel configurations require power supplies designed to load share. The increased unit cost and circuit complexity may actually result in increased system reliability and lower power system cost. Contact the manufacturer for recommendations.

In Summary

With this note we have tried to touch upon a number of general issues commonly encountered when applying power supplies or designing power systems. It is always recommended that the power system be designed along with the rest of the system, which will help minimize some of the potential problems we have discussed. Also, use the power supply manufacturers expertise and ask for assistance if the power supply is not performing as expected.