NOISE REDUCTION CHECK LIST

A. Suppressing Noise At Source
- Enclose noise sources in a shielded enclosure.
- Filter all leads leaving a noisy environment.
- Limit pulse rise times.
- Relay coils should be provided with some form of surge damping.
- Twist noisy leads together.
- Shield and twist noisy leads.
- Ground both ends of shields used to suppress radiated interference (shield does not need to be insulated).

B. Eliminating Noise Coupling
- Twist low-level signal leads.
- Place low-level leads near chassis (especially if the circuit impedance is high).
- Twist and shield signal leads (coaxial cable may be used at high frequencies).
- Shielded cables used to protect low-frequency, low-level signal leads should be grounded at one end only (coaxial cable may be used at high frequencies with shield grounded at both ends).
- Insulate shield on signal leads.
- When low-level signal leads and noisy leads are in the same connector, separate them and place the ground leads between them.
- Carry shield on signal leads through connectors on a separate pin.
- Avoid common ground leads between high- and low-level equipment.
- Keep hardware grounds separate from circuit grounds.
- Use conductive coatings in place of nonconductive coatings for protection of metallic surfaces.
- Separate noisy and quiet leads.
- Ground low-frequency, low-level circuits at one point only (high frequencies and digital logic are exceptions).
- Avoid questionable or accidental grounds.
- For very sensitive applications, operate source and load balanced to ground.
- Place sensitive equipment in shielded enclosures.
- Filter or decouple any leads entering enclosures containing sensitive equipment.
- Keep the length of sensitive leads as short as possible.
- Keep the length of leads extending beyond cable shields as short as possible.

C. Reducing Noise at Receiver
- Use only necessary bandwidth.
- Use frequency-selective filters when applicable.
- Provide proper power-supply decoupling.
- Bypass electrolytic capacitors with small high-frequency capacitors.
- Separate signal, noisy, and hardware grounds.
- Use shielded enclosures.
- With tubular capacitors, connect outside foil end to ground.

D. Guidelines for Controlling Emissions in Digital Systems
- Minimize ground inductance by using a ground plane or ground grid.
- Locate decoupling capacitors next to each IC in the system.
- Use the smallest value decoupling capacitor that will do the job.
- Use a bulk decoupling capacitor to recharge the individual IC decoupling capacitors.
- Clock signal loop areas should be kept as close to zero as possible.
- All cables should be treated to minimize their common-mode current.
- All unused inputs on logic gates should be connected to either power or ground.
- I/O drivers should be located near where the cables leave the system.
- Use the lowest-frequency clock, and slowest rise time that will do the job.
- Keep clock circuits and leads away from the I/O cables.

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