

Power Quality Issues and Recommendations

	Old Practice or Code Minimum	Helpful Procedures or Current Recommended Practice
Receptacle outlets per 20 amp circuit	13 maximum	3 to 6 maximum
Neutrals	Shared neutral, or even downsized neutral (on 3-phase systems) One neutral shared among equipment (single-phase branches)	Use double-size neutral or larger on 3-phase systems Use separate full-size neutral for each phase, back to panel
Phase Conductors	Standard phase conductor sizing per Code	Use upsized phase conductors to minimize voltage fluctuations
Circuits & Panelboards	Can be shared among many outlets and uses	Use separate branch circuits for sensitive loads, emanating from separate panelboards, supplied by separate feeders (from separate K-rated transformers, if possible)
Grounding	Can use metal conduit as grounding conductor Downsized grounding conductor Grounding electrode system can consist of as little as a metal underground water pipe and an 8-foot ground rod Use a second ground rod if first measures over 25 ohms (no resistance measurement or further action is required) Access floor used for equipotential grid in computer mainframe room No lightning or surge protection required	Use separate insulated copper wire as grounding conductor Use full-size or upsized grounding conductor Use a copper ground ring (4/0 or larger) and multiple interconnected ground rods to supplement the required electrodes in new construction Use multiple rods with a ground ring and measure before and after installation to ensure low resistance to ground (10 ohms or less is desirable, even less for certain sensitive applications, such as telecommunications facilities) Use a copper grid system for equipotential grid Use adequately sized lightning and surge protection systems
Other Equipment	Standard-rated transformers, circuit breakers, and panels Use standard-size neutral and ground buses in panel boards	Use harmonic-rated transformers and panels where electronic loads are present Use 200% rated neutral and ground buses where electronic loads are present
Circuit Breakers	Can use bolt-in or snap-in circuit breakers	Use bolt-in circuit breakers for more secure, reliable connections

An Abbreviated Bibliography of Power Quality Information Sources

- *Recommended Practice for Powering and Grounding Sensitive Electronic Equipment: IEEE Emerald Book*, Standard 1100-1999, IEEE, New York, N.Y., (ISBN 0-7381-1660-2)
- *Recommended Practice for Grounding of Industrial and Commercial Power Systems: IEEE Green Book*, Standard 142-1991, IEEE, New York, N.Y., (ISBN 1-55937-141-2)
- *National Electrical Code*, NFPA 70, National Fire Protection Assn., Quincy, Mass.
- *IAEI Soares Book on Grounding*, International Association of Electrical Inspectors, Richardson, Tex., 2001. (ISBN 1-890659-27-4)
- *Code for Protection Against Lightning*, NFPA 780, Quincy, Mass. 1992.
- *Grounding and Lightning Protection*, Robinson, M.D., Publication No. EL-5036, Electric Power Research Institute, Palo Alto, Calif., 1987.
- *Lightning Protection Systems*, Pub. No. 96A, Underwriters Laboratories Inc., Northbrook, Ill.
- *Dranetz Field Handbook for Power Quality Analysis*, Dranetz Technologies, Edison, N.J., 1991.
- *EC&M Practical Guide to Quality Power for Sensitive Electronic Equipment*, Second Edition, DeDad, John and Waggoner, Ray, Intertec Publishing, Overland Park, Kan., 1997. (ISBN 0-87288-667-0)

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