

SEMI F49-0200 (Reapproved 1021) GUIDE FOR SEMICONDUCTOR FACTORY SYSTEMS VOLTAGE SAG IMMUNITY

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NOTICE: The section symbol (§) is used to reference a numbered section, paragraph, or header and all subordinate paragraphs, headers, and embedded material (i.e., EXCEPTIONs, lists) therein. The paragraph symbol (§) is used to reference a particular numbered paragraph and embedded material therein. When duplicated (i.e., §§ and §§) the symbols are used to reference more than one section or paragraph, respectively.

1 Purpose

1.1 A guide defining a systems approach to power conditioning is needed for semiconductor and flat panel display (FPD) facilities. Semiconductor and FPD factories require high levels of power quality due to the sensitivity of equipment and process controls. Semiconductor and FPD processing equipment are especially vulnerable to voltage sags. The facility electrical system distributes power to process equipment, support equipment, and facility infrastructure equipment. Facility electrical distribution systems should be designed to integrate the voltage sag susceptibility of all the equipment with the power quality supplied by the utility. Installing effective and efficient facilities power conditioning requires identification of appropriate conditioning technologies and properly applying the conditioning equipment.

1.2 Utilizing recommendations in this Guide should result in effective power conditioning of the facility electrical distribution system such that the process equipment, associated support equipment and facilities infrastructure equipment function within acceptable ranges.

2 Scope

2.1 This Guide is intended for facilities engineers, equipment engineers, and facilities managers who specify compatibility requirements for equipment and utility services, and in particular for electrical power requirements such as those found in SEMI E51.

2.2 This Guide provides recommendations for implementing a systems approach to identification and resolution of voltage sag events that disturb the performance of semiconductor process equipment. A program recommending facilities electrical distribution system monitoring and control strategies for both the direct and indirect effect of voltage sags on wafer processing is outlined as follows:

- Reasons for monitoring and conditioning (see § 7.1).
- Facilities electrical distribution system power monitoring and conditioning (see § 7.2).
- Quantifying process equipment performance (see § 7.3).
- Quantifying support equipment and facilities infrastructure equipment performance (see § 7.4).
- Utility power monitoring strategies (see § 7.5).
- Measurement and modeling strategies (see § 7.6).
- Power enhancing and conditioning strategies for use in the facilities electrical distribution system (see § 7.7).

NOTICE: SEMI Standards and Safety Guidelines do not purport to address all safety issues associated with their use. It is the responsibility of the users of the Documents to establish appropriate safety and health practices, and determine the applicability of regulatory or other limitations prior to use.

3 Limitations

3.1 This Guide addresses power quality monitoring and conditioning solutions primarily within the facilities electrical distribution system. Process equipment and utility performance are covered in other related standards.

3.2 This Guide does not address the impact of voltage sags on equipment beyond the effect to the electrical components. Effects on interdependent equipment interlocks are not examined in detail in this Standard.

3.3 This Guide is not intended to address design or materials issues related to safety which are addressed elsewhere in the SEMI guidelines (see SEMI S2).

3.4 This Guide is not intended to supersede international, national or local codes, regulations and laws. Each should be consulted to ensure that the equipment meets regulatory requirements in each location.

4 Referenced Standards and Documents

4.1 SEMI Standards and Safety Guidelines

SEMI E51 — Guide for Typical Facilities Services and Termination Matrix

SEMI S2 — Environmental, Health, and Safety Guideline for Semiconductor Manufacturing Equipment

4.2 IEEE Standards¹

IEEE 1100 — IEEE Recommended Practice for Powering and Grounding Sensitive Electronic Equipment

IEEE 1159 — IEEE Recommended Practice on Monitoring Electrical Power Quality

IEEE 1346 — IEEE Recommended Practice for Evaluating Electric Power System Compatibility with Electronic Process Equipment

NOTICE: Unless otherwise indicated, all documents cited shall be the latest published versions.

5 Terminology

5.1 Definitions

5.1.1 *facilities infrastructure equipment* — component, modules, and systems used to transport materials like chemicals, power, water, effluent, and exhaust in semiconductor factories.

5.1.2 *process equipment* — fabrication equipment, inspection equipment, and cassette stage equipment used in semiconductor manufacturing.

5.1.3 *support equipment* — ancillary equipment not part of the process equipment main chassis.

5.1.4 *voltage sag* — a rms reduction in the ac voltage, at power frequency, for durations from half-cycle to a few seconds.

6 Impact

6.1 The primary goal of this Guide is mitigation of the effects of utility voltage sags on semiconductor processing equipment, support equipment, and facilities infrastructure equipment. A voltage sag event adversely affecting only one of these pieces of equipment can cause processing equipment to malfunction. Both the direct and indirect effect of voltage sags on process equipment should be managed. Voltage sags can affect process equipment directly through the electrical power points of connection. Voltage sags can also indirectly effect process equipment through fluctuations in air, gas, liquid, and other utility streams caused when voltage sags effect support equipment and facility infrastructure equipment.

6.2 Examples of processing equipment, support equipment, and facilities infrastructure equipment are listed below. The interaction of these three types of equipment is shown in Figure 1.

6.2.1 Process Equipment

- Etch (dry and wet)
- Film deposition (CVD and PVD)
- Thermal

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- Surface prep and clean
- Photolithography (exposure and coater/developer)
- Chemical Mechanical Polishing
- Ion Implant
- Metrology
- Automated test

6.2.2 Support Equipment

- Vacuum system (roughing, turbo, and cryogenic pumps)
- RF generator
- Residual gas analyzer (RGA)
- Water heater
- Chiller
- Photolithography stepper laser light source power supplies
- Photolithography coat/developer temperature/ humidity controllers
- Emission control (burn boxes)

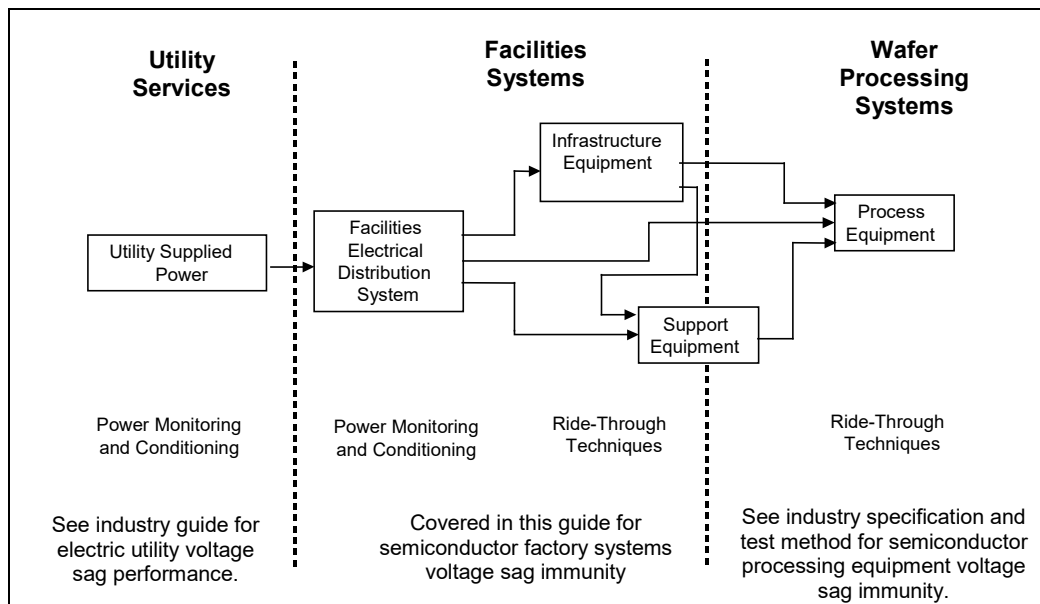


Figure 1
Power Quality Interfaces
 (See Related Documents section.)

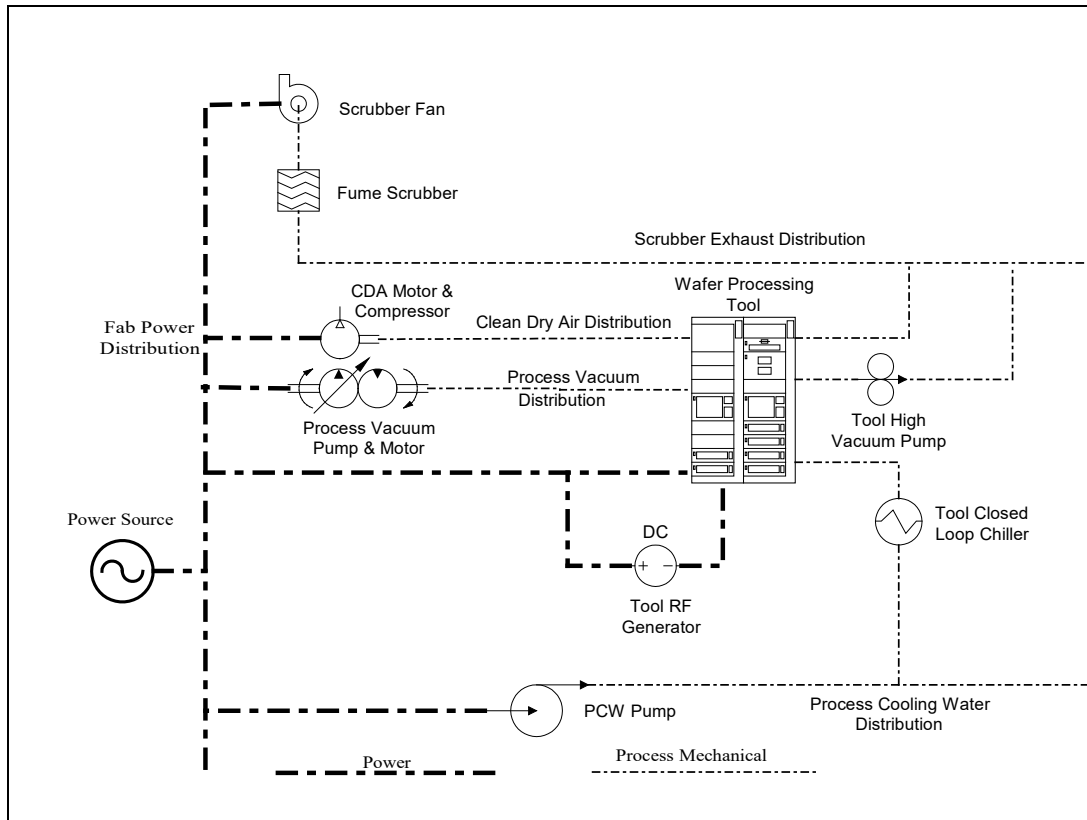


Figure 2
Typical Interconnection of Facility Infrastructure
Equipment with Process and Support Equipment

6.2.3 Facilities Infrastructure Equipment

- Exhaust systems (scrubbers and VOC exhaust fans and controls)
- Process cooling water system (pumps and controls)
- Air compressors (and controls)
- Vacuum system (pumps and controls)
- Bulk and specialty gas distribution systems (pumps and controls)
- Liquid chemical distribution systems (pumps and controls)
- Power distribution systems

7 Power Monitoring and Conditioning Recommendations

7.1 Reasons for Monitoring and Conditioning

7.1.1 Semiconductor manufacturing facility electrical distribution systems should be designed to transport power to process equipment, support equipment, and other facilities infrastructure equipment without degradation to the electrical power quality. The system should recognize electrical power that does not meet specification and provide proper power conditioning so as not to impact wafer processing.

7.1.2 Power monitoring is used to measure electrical system power quality performance for the following reasons:

1. Monitoring data can be compared to equipment voltage sag specifications to identify problems.
2. Selection and control of power conditioning devices are dependent upon monitoring measurements.